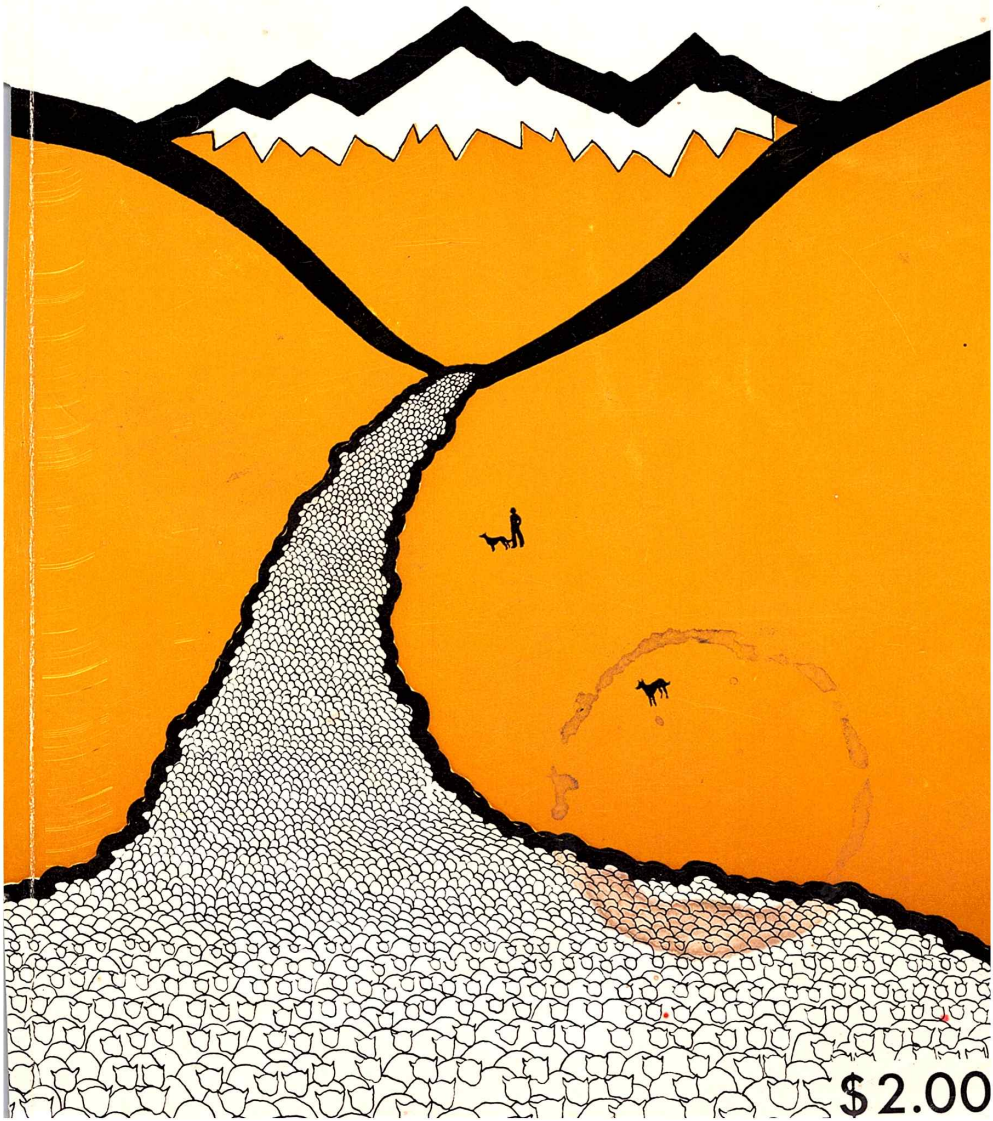
SHEEPFARMING ANNUAL 1973



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THE UTILIZATION OF BREEDS AND CROSSES IN THE NEW ZEALAND BEEF CATTLE INDUSTRY

A. L. RAE*

IN the past 5 to 10 years, a rather bewildering array of new breeds has become available to the beef cattle industry in New Zealand. Breeds such as the Charolais, Simmental, Limousin, Maine-Anjou, Blonde Aquitaine, Pie Rouge, South Devon, Sussex, Lincoln Red, Meuse-Rhine-Yssel (MRY), and Chiana are now available in the country either as animals or as semen. It is clear that it will be many years before adequate information is available on the relative merits of these breeds and their crosses. Nevertheless it is vital that an examination be made of the ways in which these breeds can be utilized in improving the productivity of the beef industry. Hence the intention in this paper is, first, to outline the needs and objectives in improving beef production. Then an assessment will be made of the various ways of using breed and cross differences in meeting the requirements of the industry. Finally, consideration will be given to the information presently available on some of the exotic breeds and some suggestions made as to the likely role they could play in New Zealand beef production.

OBJECTIVES IN IMPROVEMENT

It is important to remember that there are *two* phases in the production cycle of the beef animal in a single-suckling herd. The first phase is that of *calf production.* In this, it is the traits of the cow that are of most significance—high fertility and regularity of calving, adequate milk production and mothering ability to wean heavy calves. The second phase is that of *growth* or *weight production.* This refers to the post-weaning stage of growth up to the slaughter of the animal for beef. The important traits in the efficiency of this phase of production are growth rate, carcass composition and the eating qualities of the beef.

In considering these two phases, several points need to be stressed:

(1) Efficiency of calf production is relatively much more important than efficiency in the growth phase. This arises because the

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cow herd, including the calves up to weaning, consumes about twice as much feed as is needed to carry through the calves produced by the herd from weaning to slaughter. So, overall, the traits which contribute to cow efficiency are very much more important than those contributing to the efficiency of the steer.

(2) The functions performed by the cow are very different from those of the steer. Consequently, the traits required in the cow are different from and may be antagonistic to those needed in the steer phase of production. This is shown in Table 1 where the traits required for cows and for steers are listed and their desirability for each phase of production is indicated. The main conflicts arise from the genetic relationships between mature size, rate of growth and rate of maturity. Thus, while small cows have the advantage of lower maintenance requirements, this is offset to some extent by the fact that they have a lower rate of gain and will pass this tendency on to their steer calves which are then at a disadvantage in the second phase of beef production.

TABLE 1: TRAITS REQUIRED IN THE COW AND STEER

Trait	*Cow*	*Steer*
High fertility	+	0
Easy calving	+	0
Good milking ability	+	0
Small size	+	−
Good temperament	+	+
High growth rate	−	+
High yielding carcass	0	+
Tender, palatable beef	0	+

+indicates that the trait is desirable.
−is undesirable.
0 neutral or of little importance.

(3) It is necessary to note some of the genetic properties of the various cow and steer traits. The two properties of most concern are: (a) the rate at which the trait responds to selection for it; and (b) the extent to which the trait shows hybrid vigour in crosses. The results of work done overseas are summarized in Table 2. It is clear that the more important traits of the breeding cow respond only little to selection but show a substantial amount of hybrid vigour. On the other hand, the steer traits can be changed readily by selection but

TABLE 2: CLASSIFICATION OF TRAITS BASED ON RESPONSE TO SELECTION AND AMOUNT OF HYBRID VIGOUR

Trait		*Response to Selection*	*Amount of Hybrid Vigour*
1	Fertility Mothering ability Calving interval	Very slow	Much (10% or more)
2	Growth rate Weaning weight Overall conformation Milk yield	Medium	Medium (5 to 10%)
3	Mature weight Tenderness	Fast	Little (5% or less)

show only a moderate amount of hybrid vigour. Consequently it is important that every avenue should be explored in order to set up production systems which make maximum use of hybrid vigour primarily in the cow herd but also secondarily in the growth of the slaughter animal. In effect, crossbreeding may permit the production of a better combination of the cow and steer components of performance than can be obtained within a single breed.

UTILIZATION OF BREED DIFFERENCES

It is now necessary to examine in detail the various methods available to use breed differences in efficient beef production.

(1) Breed Replacement

If a particular breed proved to be superior in both its cow and steer traits to any existing breeds and crosses, then the objective would be to replace the less productive breeds by the superior breed. This can be done in two ways: (a) By grading up (*i.e.*, the continuing use of bulls of the superior breed). This is a commonly-used method and is well known in the New Zealand livestock scene. For example, the replacement of the Shorthorn breed by the Jersey in the dairy industry and by the Angus in the beef industry was essentially accomplished by this process. (b) By doing less culling among individuals of the superior breed and so expanding its numbers to replace the other breeds. This is a slower, less efficient procedure, but has been used in the expansion of the Friesian breed in Britain and Europe (in contrast to the grading up process operating in the New Zealand dairy

industry at present). Both these processes will be used in the establishment of the exotic breeds in New Zealand, but whether they will be involved in the commercial industry is more questionable. It could be that the Limousin may be used to grade up the Angus breed and the Simmental to grade up the Hereford. In each case, however, the crucial question would be whether the exotic breed is better in its cow performance than the local breeds. To answer this requires comparisons of straightbred or graded-up herds of the breeds involved over a range of conditions, especially on hill country. Hence answers are not likely to be forthcoming in the near future.

(2) Specific Two-breed Crosses

An example of this system would be the Southdown-Romney cross for export lamb production. It is of limited use in a situation where reproductive rates are low as in cattle. It is likely to take place only where a system of stratification has evolved whereby cull or cast-for-age cows from hill herds are brought on to better country and crossed to bulls of another breed. Only a very little of this type of crossing is practised in New Zealand. In using it, one would gain the full amount of hybrid vigour in steer performance traits but no hybrid vigour in cow performance.

(3) Three-way Cross

This system consists in mating a superior sire breed to cows resulting from a cross between two breeds chosen largely for their maternal traits. In words commonly used nowadays, it is the use of the big terminal sire on an F_1 cow. The cow, being a first cross between two breeds will show maximum hybrid vigour for the cow performance traits. The terminal sire is chosen for its high level of performance in the steer traits and usually both sexes from this cross will be slaughtered. Again this will give maximum hybrid vigour for the traits involved in post-weaning growth and production.

This is a system of production that needs examination under New Zealand conditions. The immediate practical difficulty is that it requires about 60 to 65 straightbred cattle of breed B to maintain 100 A $\times$ B cows for producing slaughter cattle. It is this fact, plus the consideration that the first-cross cow is chosen to be good for maternal traits, which suggests that the dairy industry could play a part in the system. For example, one would consider

in this context the production of an Angus × Jersey, or Hereford × Friesian cow by crossing the appropriate sire with surplus Jersey or Friesian cows. Then these first-cross cows would be mated with the big terminal sire breeds such as Charolais or Simmental. It could be that the surplus breeding capacity of the dairy industry would be more efficiently used in producing appropriate first-cross cows than in producing stock for slaughter.

(4) Rotational Crossing

Rotational crossbreeding, or the use in sequence of sires of two or more breeds, has the advantage of utilizing a high proportion of the maximum potential hybrid vigour in both cow and steer performance. It has the disadvantage that each breed contributes on average to the same extent as a sire breed and as a dam breed in the cross. Consequently selection needs to be for both the cow and steer performance traits in each breed and thus no breed specialization can take place. The number of breeds used in the rotation is relevant, a two-breed rotation retaining 2/3 of the hybrid vigour effects for both cow and steer traits, a three-breed rotation retaining 6/7 and a four-breed rotation retaining 14/15 of the hybrid vigour effects.

In New Zealand, many breeders have handled the Angus-Hereford cross herd more-or-less as a two-breed rotation. There is need for more consideration to be given to the three-breed rotation. It is a simple system and, because female replacements are bred within the herd, it fits in well with the typical hill country run herd.

The use of a specialized sire breed on cows produced by a two-breed rotation is a system that combines some of the advantages of the three-way and rotational crossing. Such a system would involve crossing a large terminal sire such as the Charolais or Simmental to an Angus × Hereford rotationally-bred surplus cow. In this case all of the hybrid vigour in steer performance traits is utilized as well as a large part of the maternal hybrid vigour.

(5) Synthetic Breeds

In this system, the cross is interbred and established as a new and separate breed. This procedure is well known in sheep in New Zealand. It offers less opportunity than rotational crossing for retaining hybrid vigour in both cow and steer performance.

Once interbreeding has started, then the problems of improvement are essentially the same as in any other breed.

COMPARISONS BETWEEN BREEDS

Experimental comparisons of exotic breeds in New Zealand are limited to Charolais × Jersey and Charolais × Friesian cattle, although some field experience is now becoming available with other crosses. The results of Barton (1968) and of Everitt (1972) are in general agreement as to the performance of the Charolais-Jersey cross steers. They grew rapidly but not significantly better than the Friesian-Jersey cross or as well as the Friesian. Their percentage yield of meat or trimmed cuts was better than the Friesian, Friesian × Jersey and Angus cattle. There was a higher mortality rate, especially at calving and in the first three months. Hollard (1968) noted that the Charolais × Friesian grew about as well as the Friesian.

A growing amount of information on the comparative beef performance of the exotic breeds is becoming available from trials which are being undertaken not only in Europe but also in Canada, Argentina, South West Africa, and South Africa. It is noted that the results of the different trials are often not repeatable because of small numbers or because of insufficient sampling of the breeds involved. However, it is possible to classify the breeds into groups. Group 1 includes the Charolais, Simmental, Romagna, Chiana and German Yellow. Present results show little difference between these breeds in growth rate, yield of red meat, rate of maturity, leanness and calving difficulties. Group 2 includes the Limousin, Blonde Aquitaine, Maine-Anjou, the MRY, the South Devon and the British Friesian. These breeds are smaller, slightly slower in growth, but high yielding and lean. Group 3 includes the continental Friesians, the Devon, Sussex and Danish Red. Finally the last group includes the remaining British beef breeds—the Hereford, Shorthorn and Angus.

It is noted that there is a clear positive correlation between daily gain and mature weight, and a negative correlation between daily gain and fatness, *i.e.,* breeds with a large mature size grow most rapidly and mature most slowly. There is a negative association between daily gain in weight and amount of food needed to achieve this gain. Also the larger breeds when slaughtered at the same weights tend to have more muscle in the carcass and hence a higher muscle to bone ratio. Proportions of the cuts are not very different. The less desirable aspects of large size are

a longer gestation, heavier calves at birth, more calving difficulties and more stillbirths.

It is important to note that some breeds deviate in one or more traits from this general regression on size. Of special note is the Limousin which appears to have a higher muscle to bone ratio (due to more muscle and less bone) than is expected for its size. This is reflected in a larger eye muscle area. In contrast, the Friesian types appear to have more bone than breeds of comparable size.

On the whole, evidence from work in U.S.A. and Canada confirms the picture outlined above. A very detailed comparison of a number of breeds is being undertaken at the U.S. Meat Animal Research Center at Clay Center, Nebraska (including South Devon, Limousin, Simmental, Charolais and Jersey). Generally the Simmental crosses produced from Angus and Hereford cows are similar to Charolais crosses in growth rate, birth weights, calving difficulty and carcass traits. Growth of the Limousin crosses is less than the Charolais or Simmental but above the British beef breeds.

In considering this information, one must remember that it can only be a very general guide. It is necessary to recall that the New Zealand information on the Charolais crosses compared with the Friesian does not altogether line up with British experience and that generally the comparisons which have been made overseas are at comparatively high levels of nutrition. The comparative advantage of the large, late-maturing beast may not necessarily hold under lower levels of feeding.

Nevertheless this information serves as a base for examining the possibilities in breed exploitation in New Zealand. First, the large terminal sire breeds such as the Charolais, Simmental, Chiana and perhaps South Devon and Limousin may be grouped together. In the writer's opinion, obtaining optimum use of these breeds will require the development of a three-way cross system. A crucial point is the production of a cow which will be able to produce calves sired by these large breeds with little trouble at calving. More and more, this seems to require the Jersey to be involved as one of the breeds. This also fits in with the idea of these F_1 cows being produced from the surplus breeding capacity in the dairy industry. The use of the Jersey, however, has a disadvantage in that the male calves born as a by-product of the production of these F_1 cows are comparatively slow in growth rate and may be inclined to yellow fat. This may favour an alternative

such as the production of the Hereford × Friesian female rather than the Angus × Jersey. It is probable that the three-way cross system would be a specialized operation carried out on reasonably good country. The fact that this system (used for a long time in Great Britain) is now developing rapidly in many other countries is a justification for a careful assessment of its use in New Zealand.

There is a further group of breeds which includes the Simmental, Maine-Anjou and Friesians of various types where growthiness and high milk production are combined. These breeds could well contribute to a rotational crossing programme along with present breeds. Again this system of breeding, because it supplies its own replacements, merits more consideration than it has yet been given in New Zealand.

The Limousin has a good reputation for carcass merit in the sense of the British breeds although its growth rate is substantially better. Crossing with the Angus to form a synthetic breed could be a possible use of this breed. It could also fit in (perhaps where better marbling in the meat is required) as a terminal sire or in a rotation. The Blonde Aquitaine, South Devon and Lincoln Red could also fall into the same sort of pattern.

In conclusion there would appear to be little doubt that beef production will need to become a very much more specialized industry in New Zealand. In this paper the writer has tried to show the ways in which the breeds can be utilized by cross-breeding systems. The hope is that producers can be induced to try out these systems and to sort out how best they may operate in different environmental and management situations. However, it is clear that much less reliance will be placed on trying to get all the good traits together in one breed. Rather, crosses will be "tailor-made" for specific purposes.

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BEEF BREEDING PROGRAMME: LANDS AND SURVEY DEPARTMENT, ROTORUA

A. E. GIBSON* and D. C. DALTON†

THE Rotorua Land Development Branch of the Lands and Survey Department encompasses the counties of Tauranga, Whakatane, Rotorua and Taupo.

From 1930, when the Crown made a first serious attempt to develop land for settlement from an unimproved state at Ngakuru, until 1970, when the 1,000th farm was settled, some 420,000 acres had been developed. From 1948 onwards some 20,000 to 25,000 acres were developed annually to meet the needs of ex-servicemen and civilian settlement, and it was not until 1965 that the backlog had been overtaken. From this time settlers were demanding more age and consolidation in pastures before accepting settlement, conservation was becoming an acceptable word, and in fact erosion was increasingly evident. In addition, there was a need to recover more of the costs of development before settlement, and so the rate of development and settlement slowed down.

With this change of objectives from one of creating farms for settlement, to one of developing land, recovering the costs and then settling it, came a necessity to dispense with the wether and bullock in favour of more productive breeding stock. The Branch at this time was farming some 170,000 acres in various stages of development and consolidation, and the rate of development since then has roughly equated with the area settled. Table 1 gives comparative stock figures for 1965-6 and 1972-3.

The rapid increase in breeding stock over this period, with the necessity to purchase increasing numbers of sires, posed a number of problems, for example:

(1) Whether to stay with the Romney and Angus breeds which constituted 90% of the flocks and herds of the Rotorua Land Development Branch.

(2) If the Branch were to stay with them rather than embark on a crossbreeding programme, where could sires be obtained that would improve their genetic potential?

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TABLE 1: COMPARATIVE STOCK FIGURES

	1965-6	*1972-3*
Breeding ewes ('000)	201	348
Other sheep ('000)	127	131
Total sheep	328	479
Breeding cows ('000)	20	34
Other cattle ('000)	53	29
Total cattle	73	63
Area in grass ('000 acres)	172	169
Stock units per acre in grass	3.59	4.70
Lambing %	86.7	88.0
Calving %	83.9	83.0

It is not the intention in this paper to discuss the sheep policy which has been adopted, but in five years of intensive selection for fertility it has been possible to establish an elite flock of 1,000 Romney ewes which docked 164% of lambs in the 1972 spring. The male progeny of these sheep are being used as sires on several of the blocks in comparative trial work with sires purchased from commercial breeders.

To winter 34,000 cows it is necessary to mate 40,000 cows and heifers in the spring, requiring an annual replacement of 250 to 280 bulls; these have cost about $125,000. This sum could well be doubled in the foreseeable future if upward trends in bull prices continue. Traditionally these animals have been purchased from recognized commercial breeders throughout the North Island, but a 70% increase in sire requirements over a period of seven years has placed the Branch in a position where animals to the standard required are not readily available.

Cairney and Magnusson (1970) showed that 45% of all registered beef herds in New Zealand had fewer than 20 breeding cows and that only 28% had more than 40. Only 3% of herds had more than 100 cows, and, of all registered herds, only 25% approximately were recording growth data. Wallace (1971) pointed out that there are 30,000 registered beef cows in New Zealand which at best could provide the industry with 14,000 bulls annually. Allowing that some artificial insemination is carried out, and that some beef animals are mated to bulls of dairy origin, 17,000 are still required annually by the industry.

It is clear that there is little room for improvement or selection if bulls are to be purchased from traditional stud stock breeders.

The position is illustrated in Fig. 1. The left triangle indicates the present structure where (a) there is an absolute division

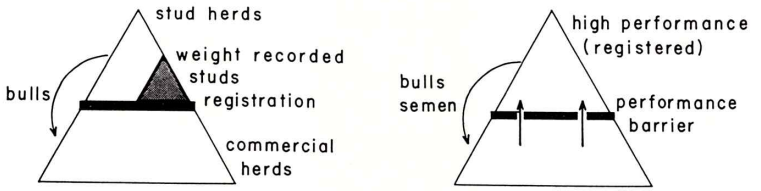

FIG. 1: *Breed and industry structure.*

between stud and commercial herds, based solely on pedigree registration; and (b) there is a one-way flow of bulls from stud to commercial herds with no return flow. Improvements within the stud herds come only from within those herds.

The right triangle indicates a more acceptable structure, the main features of which are (a) the basic triangle is still acceptable where improvement is concentrated in a small number of herds to be spread to a larger number of herds; (b) the division between the registered and commercial herds is now perforated so that animals of proven merit in commercial herds can be exploited in the production of males for use in the whole cattle population.

The decision therefore was to carry out an improvement programme with the Angus breed. It was based on the following factors:

(1) The Branch has a large population of this breed under its control giving scope for intensive selection to form a high-performing nucleus herd of female cattle.

(2) There was no guarantee that bulls of other breeds would be available in large numbers or to the standard required.

(3) The stock run will eventually be sold to settlers, who in general prefer straightbred animals.

STAGES OF THE BREEDING PROGRAMME

The first stage was to agree upon a simple aim for the breeding programme as it had to be run under commercial conditions. The aim was to breed sires of good growth rate potential from cows which had produced calves of heavy weight at weaning. All animals had to be free from any physical defects.

The second stage was to locate some good cows from herds under the control of the Branch where no records had previously

been maintained. It was decided in this instance that a good cow was a cow that weaned a good calf—a very simple decision.

At weaning on a central block (Waihora) and later on a series of surrounding blocks, the best calves, or the heaviest, if scales were available, were turned back with the cows. A few days later, after they were correctly mothered up, they were brought back into the yards with their dams. The dams were tagged and thus permanently identified.

All the identified cows were then moved to the central Waihora block. There was a lot of work involved with these cattle in terms of careful inspection and culling for any important physical defects. The cows were then fully recorded. The information collected was as follows:

At birth (calf given a numbered brass eartag): date of birth; sex; dam number; general comments on calf if necessary.

(The sire of the calf was recorded on each cow's permanent record card.)

At weaning: Actual weight. This was corrected for age. Age of dam was not known. Sexes were kept separate after weaning.

At 14 months: Actual and corrected weight. At this age heifers were joined with the bull, hence growth performance comparisons had to be terminated as the cattle could not be treated similarly.

It was considered important for accuracy to tag calves as soon after birth as possible. In the newly-screened cows stockmen found this caused some problems. The manager's experience highlighted the importance of quiet handling in yards whenever the cattle were worked—all men to be on foot and all dogs tied up. In the winter period, prior to calving, it was important to feed out hay, walking among the cattle, again with no dogs.

Some cows still caused problems at calving when their calves were caught, but by the second season they had accepted the system. Any cows which did not respond to quiet management were culled. The heifers which have been reared and calved on Waihora have been especially quiet.

When cows, as opposed to ewes, are formed into a central herd after weaning, they are already pregnant. They have thus to be "emptied" before they can be mated to superior bulls. This delays progress for a year.

Perhaps the greatest initial problem, however, is to locate genetically-superior sires to put across these cows in the initial years of the breeding scheme. There always appears to be

sufficient supply of good sires around, in terms of opinion and hearsay, but their performance specifications and their reliability leave much to be desired.

The "best-bets" are top, performance-tested bulls out of the larger studs which have been weight recorded and their records used for effective selection over a long period of years. This was the basis for selection used in the programme where bulls were bought privately and at public auction. It was not possible of course to compare bulls from a range of stud herds performance-tested in different environments. They could be compared only by progeny testing and this became a basic part of the programme.

THE BREEDING PLAN

The breeding plan is shown in Fig. 2. In 1972 the whole herd was used for progeny testing sires. Within the herd the heifer calves were selected on the basis of a performance test for growth while the bulls were performance tested outside the herd at a different location.

Progeny testing requires facilities for single-sire mating for at least two cycles. This is an effective challenge to the bulls as they must sire sufficient calves for an adequate test in this period. Slow-working bulls are automatically eliminated. After two cycles, follow-up bulls are used to ensure that empty cows through a bull becoming infertile, is not a problem. Care is needed in interpreting parentage near the point of changeover of the bulls.

From 1973, following the formation of an elite group of cows in the herd, there are cows with three consecutive records. Those

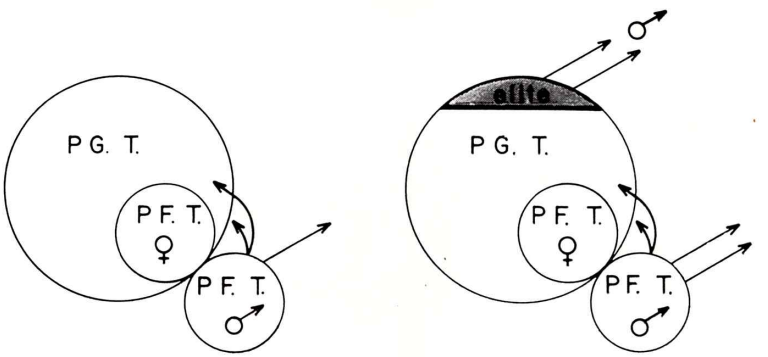

FIG. 2: *Breeding programme: left, in 1972; right, from 1973. PG.T.= progeny-tested sires; PF.T.=performance-tested bulls.*

with the highest weight of calf weaned will be mated to the top, progeny-tested sires to produce as many bulls as possible.

Progeny testing will be done within the remainder of the herd to test new sires purchased from the outside population along with the best home-bred bulls from the performance test. Heifer replacements will again come from the performance test within the herd.

It is important that the top, progeny-tested bull is used in the progeny-test herd as a "reference sire", until his record is beaten by another bull. Of course he is essential for the elite cows also, where he may have to be used through artificial insemination because of demands on his services.

There have been two screenings of cows from outside blocks but this has been stopped temporarily until information is obtained about possible progress from within the herd at present. Further screening will be used if and when required to fit in with selection and culling from the herd. The herd should improve by the use of only the best daughters of sires with above-average progeny tests and subsequently progeny of the elite group.

The situation beyond 1973 is conjecture, but a likely representation is shown in Fig. 3. The left diagram illustrates a situation where the elite portion of the herd would increase and the number of cows available for progeny testing would decrease and eventually be eliminated. The situation shown in the centre and right sections would then be inevitable where there was an elite herd producing the maximum number of bulls to go on to the blocks, and where there was a separate herd for progeny testing, say, on another block.

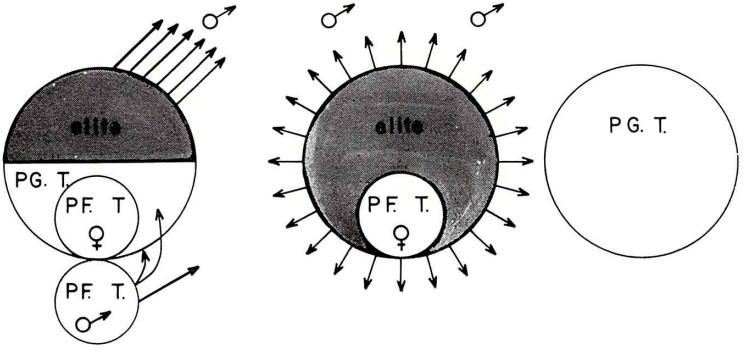

FIG. 3: *Breeding plan beyond 1973.*

A dilemma arises when cows are needed for progeny testing, but when the aim is the maximum production of sires, top cows should be mated to top bulls to avoid the chance of their being mated to an average bull in a progeny test.

CAN PROGRESS BE MEASURED?

The Waihora herd is a commercial, not a research, herd. Even so it is important to measure progress. In a research situation an unselected control herd would be used as a base line for this purpose.

It is dangerous to look at weaning weights, as those in Table 2, and from them assume progress. Calves were weaned at different ages because of management decisions based on seasons. The seasons also improved from 1970 through to 1972; hence better weights would be expected.

TABLE 2: CALF WEANING WEIGHTS (lb)

			Males			*Females*		
Crop	*Mean Age (days)*	*Dam Age*	*Weaning Wt (lb)*	*Total Calves*	*No. Retained*	*Weaning Wt (lb)*	*Total Calves*	*No. Retained*
1970	178	mixed	338	153	140	317	167	161
1971	140	mixed	347	313	266	319	291	228
1972	164	mixed	404	224	200	373	235	214
		2 yr	360	41	35	336	43	41

How then can progress be measured?

(1) By bringing into the bull performance test each year a sample of bull calves from the surrounding blocks. This should show up any improved growth potential of the Waihora-bred bull calves if it existed.

(2) Through the progeny test where Waihora-bred bulls will be tested against the best industry bulls available, especially through artificial insemination. Certain bulls will be used as reference sires against which other sires can be rated. Co-operation with other breeding groups is an exciting possibility using the reference sire principle.

WHAT IS A VALID PROGENY TEST?

The two basic points of a progeny test must be strictly adhered to. These are that the sires are given a random selection of cows

to mate and that all calves born are included in any assessment. The temptation to cull or treat differentially the tail-end calves must be resisted.

For a reliable test, most people accept a minimum of 10 to 15 progeny of either sex by each sire. When total numbers of calves come down below 10 to 15 then no reliable conclusions can be drawn.

It is dangerous simply to add up the average weight of the calves by each sire and assume that any differences are genetically important. Corrections must be made for age of animal, sex and age of dam where possible. In these data, age of dam was not known so had to be ignored. However, calves out of yearlings were not included in the test, hence it was based on mature dams.

The first progeny test in 1971 is presented in Table 3 and covers growth from weaning through till 14 months of age. The deviation in 550-day weight from the herd average of each sire is presented along with his purchase price. The consistent performance of bull A is very clear. His calves were heaviest at weaning showing that his influence was apparent even through the maternal influence of the dams. This superior merit was maintained up to 14 months of age, *i.e.*, at the October weighing.

TABLE 3: PROGENY TEST 1971. WEANING TO 14 MONTHS OF AGE

(Least square means)

Bull Code	*Herd Deviation (%)*	*Price ($)*	*No. Progeny*	*Weaning Wt (lb)*	*Jun. Wt (lb)*	*Oct. Wt (lb)*
A	+118	600	34	370 (1)	460 (1)	556 (1)
B	unknown	750	20	345 (2)	428 (3=)	542 (2)
C	+111	1600	58	343 (3=)	440 (2)	529 (3)
D	+113	700	30	343 (3=)	428 (3=)	528 (4)
E	+113	1100	22	334 (4)	425 (4)	522 (5)

Figures in parentheses indicate the ranking order of the sires at each weighing.

The progeny of bull B were behind in June but, thereafter, made a rapid gain up to October. Is growth like this acceptable, compared with consistent growth?

The results of the second progeny test in 1972 are presented in Table 4 but they refer only to the weaning weight of the calves.

This is clearly a very valuable progeny test. It includes a good number of bulls with adequate numbers of progeny per bull.

TABLE 4: PROGENY TEST 1972. WEANING WEIGHTS ONLY

Bull Code	*Purchase Price ($)*	*No. of Progeny*	*Weaning Wt (lb)*	*Deviation (lb)*
A	2000	31	431	+42
B	950	26	409	+19
C	1200	33	407	+18
D	1600	28	404	+15
E	385	25	402	+13
F	800	30	399	+10
LS	*	21	399	+ 9
G	800	13	398	+ 8
LS	*	34	393	+ 4
H	1200	29	391	+ 1
I	1000	19	382	− 7
J	†	10	378	−11
K	600	21	377	−12
L	475	21	377	−12
M	1000	35	364	−25

*Bred by Lands and Survey Department.
†Semen only purchased.

Bull A looks to be a potentially valuable animal to have lifted weaning weight by 42 lb above the average of all the bulls. The two LS bulls were of unknown parentage but were top growth-rate bulls from the first performance test carried out by the Branch. The fact that they are round the average performance of a group of superior industry bulls is interesting.

Table 4 indicates that price is no guarantee of genetic merit. Bull A was the top performance tested sire in his herd group. Bulls D and H came from the same stud as bull A. Their within-herd performance is accurately reflected in their progeny performance, supporting the principle that performance testing within herds is a sound basic tool.

However, in another environment, bull M was also a top performance bull in its herd. This indicates that, before bulls are exploited widely through artificial insemination, a progeny test is essential.

YEARLING MATING

Specifications adopted in the early stages of the programme included the ability of a female to calve at 2 years of age, conceive annually within 45 days of joining with the bull and rear a calf to an acceptable weaning weight.

In the spring of 1971, 110 14-month heifers at 500 lb liveweight or heavier were joined with bulls. They were joined 20 days before bulls were joined with the older cows, and the bulls were left out for 45 days; there were no follow-up bulls. The heifers were well fed throughout pregnancy and averaged 884 lb by early July. Thirteen dry heifers were sold pre-winter. Two animals had to be assisted in calving and 88 live calves were produced. Calf weights at weaning are shown in Table 2.

All animals lost condition post-calving but by the time the bulls were joined in the spring of 1972, they had regained their pre-calving liveweight. Of the 88 2-year heifers retained, 85 are again in-calf.

The minimum liveweight of 14-month heifers joined in 1972 was reduced to a lower limit of 480 lb. On pregnancy testing, 93 were diagnosed as in-calf and 21 as empty. These latter animals have been culled.

From work done on Lands and Survey, Rotorua, Waikite Block and three other locations, and after studying records of 9,732 matings of Angus, Hereford and crossbred females, including 1,828 yearlings, Dr A. H. Carter of Ruakura recommends yearling mating in the interests of efficient calf production and faster genetic improvement, with a suggested minimum joining weight of 430 lb for heifers. Preliminary studies at Waihora suggest that yearling mating should be undertaken with heifers weighing 480 to 500 lb.

THE EXPLOITATION OF BULLS BRED AT WAIHORA

As with the heifers, performance testing is completed at about the 400-day stage. The top performing sons of the top progeny testing sires will be used as sires in the random selection group at Waihora at 15 months of age.

All bulls with below-average growth rate are discarded. Above-average animals are culled for feet or conformation faults. In 1972, 55 bulls were retained for distribution to blocks and in 1973 a minimum of 75 bulls measuring up to these rigid specifications will be available as replacement sires. The next step will be to progeny test these bulls in competition with bulls purchased from breeders.

Top progeny testing bulls have been made available to the industry through Herd Improvement Associations.

ARTIFICIAL INSEMINATION

In 1971 semen from three industry bulls was used at Waihora. Conception rate was low and sufficient progeny to justify inclusion in Table 4 were obtained from only bull J. Work done at Goudies block in the 1972 mating, however, indicates that large-scale artificial insemination work with beef herds is both practical and efficient. Under the direction of Dr Carter and Dr R. L. Baker of Ruakura, 1,263 suckling cows, dry cows and heifers were inseminated over two cycles for cows and three cycles for dry cows and heifers with fresh semen from imported French bulls and other breeds in the evaluation programme of the Ministry of Agriculture and Fisheries.

Pregnancy testing in May showed that 957 cows or 75.8% are in-calf, while a further 57 are in-calf to either artificial insemination or follow-up bulls while 158 are in-calf to follow-up bulls. With experience in heat detection and with quieter cows it is certain that this result can be improved.

In conclusion, it is stressed that all this exercise has shown is that there is a vast untapped source of superior genetic material within the Angus breed. This must be identified and exploited through the simple techniques of recording, performance testing, progeny testing and artificial insemination, so that it can be channelled to the commercial beef producer.

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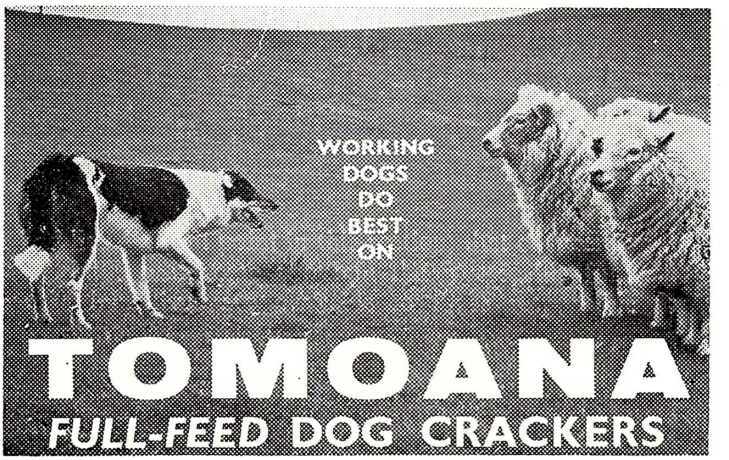

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THE NEW ZEALAND MEAT INDUSTRY

CHARLES HILGENDORF*

THE introduction to the Meat Export Control Act 1921-2 says that the reason for the legislation was to improve the net returns to the meat producer and so promote the economic welfare of New Zealand. This Act, together with the Meat Act, gave the Meat Producers Board very wide powers over most aspects of the industry—grading, licensing of freezing works, promotion, shipping and marketing.

GRADING

The aim of any grading system should be to put like with like, using those criteria which the end user considers important. For our purposes the end user is usually either a retailer or a manufacturer. There is a tendency by some people to think that the retailer can be by-passed and consideration given only to what the housewife does or should want. In the long run, of course, the housewife is of overwhelming importance but the butcher considers (probably rightly) that he knows her individual requirements better than anyone.

The object of a good grading system is to enable meat to be bought and sold on specification. Unlike most meat around the world, the vast preponderance of New Zealand exports is sold in this way so our grading system is presumably moderately satisfactory. Times change and over the years the Board has not hesitated to modify and improve its system, but times are changing even faster now. Meat is being sold in a great number of new countries; about one-quarter is sold for manufacturing and an increasing amount as cuts. These facts make it necessary to look again at the requirements and criteria used in grading.

Thus a committee has been set up to look at the whole question —a committee not of experts (there are plenty of these, but unfortunately they do not agree), but of people who we think can sift evidence in the necessary manner.

A grading system is of value to the buyer but it is also of great value to the seller and producer. It is important, first, in enabling the retailer to buy with confidence and it encourages him to pay a higher price. Secondly, it saves him time and money since he

*Chairman, New Zealand Meat Producers Board.

can buy meat by telephone; he does not have to inspect it. Thirdly, and most important, a grading system reflects back to the producer the price the buyer is willing to pay for each grade, and, of course, the only test of quality is what the buyer is willing to pay.

In the past there have been attempts (and still are in some places by some people) to classify various types of meat as best, second best and so on. Though some of the names of our grades give the impression that this might still be so, the Board has steadily moved away from descriptive names, *e.g.*, Alpha, Omega, and is quite clear that the only criterion of quality in meat is what the buyer is willing to pay for it.

LICENSING OF FREEZING WORKS

No new freezing works may be built nor an existing one extended unless recommended to the Minister by the Meat Producers Board. Most administrative decisions are compromises and those connected with the licensing of freezing works are no exception. Every farmer wants his stock killed on the day or at least during the week, most suitable to him. On the other hand, all farmers want a low killing and freezing charge, and these two requirements are not compatible. Either farmers must at times wait to have their stock killed or there is very great over-capacity (under-use) of the works facilities available. It can of course be argued that there is always great under-use. Most freezing works are used only for seven or eight hours a day, for five days a week, even during the busiest season.

Some people think the solution is for farmers to have stock for slaughter all the year round but it is as well to remember two facts. First, the efficiency of the meat industry in New Zealand relies on grass, and grass grows to a seasonal pattern—or usually does. Secondly, though there is much interdependence, the freezing industry is a service industry. Stock is not simply raw material for the freezing works.

Over the years the Board has found that some rather rough arithmetic is helpful, though each case is to some extent different and must be treated on its merits. It has been found that, in districts where a works working at full capacity can kill its normal throughput of sheep and lambs in less than 100 days, farmers are reasonably well served as far as sheep are concerned. If it takes more than 100 days, difficulties arise.

It does appear, however, that as stocking rates rise and farming becomes more intensive, farmers have less room to manoeuvre in difficult periods and improved killing facilities are necessary.

SHIPPING

No meat may be exported by sea or air without the consent of the Board. This simple rule gives the Board the ability to control the flow of meat on to a market, to decide what shipping lines may trade in meat and to negotiate, if it wishes, rates of freight.

The timing and regularity of flow of, for instance, lamb on to the United Kingdom market are the very essence of any efficient marketing plan. Very roughly, the British market needs 7,000 tons of New Zealand lamb arriving each week during the first six months of the year, and 4,000 tons each week during the second six months. With half-a-dozen major ports in the United Kingdom and rather more in New Zealand, this is quite a complex operation. The overall plan is agreed to by the exporters and the Board at the beginning of each season in quite an amicable manner. Naturally the implementation is not always perfect. Weather, ship breakdowns and strikes can be disruptive but are nothing like so bad as no plan at all. The thought of a score of exporters supplying a sensitive market of this kind without any co-ordination is alarming.

Because of the number of freezing works, the plan is a compromise between a perfect service (weekly sailings from each major New Zealand port for each major United Kingdom port) and reasonable freight rates. The first essential factor in an economical shipping service is to ensure that the ships are full or nearly so. This is why the Board allows only a limited number of shipping lines to operate in any one trade.

Three-and-a-half lines (all British) operate the United Kingdom refrigerated trade; 3, the East Coast North America trade (1 British, 1 German, 1 U.S.), 5, the Japanese trade (2 Japanese, 2 British, 1 Danish). Shipping conferences have come in for a great deal of criticism over the years and nearly all the bad things that have been said about them are true—the only trouble is that we cannot do without them.

A conference is a monopoly, though there is, or may be, competition within the conference itself. On the other hand, in a refrigerated trade as complicated as that of New Zealand with the United Kingdom, it is absolutely essential to have a single

authority to deal with. In a trade of this volume and sophistication, charters or lines on an in-and-out basis simply do not make sense; for one thing the refrigerated tonnage required is large by world standards and has to be planned well in advance. Nonetheless, it is not essential that the same companies or the same combination of companies should be employed forever.

Partly for historical reasons, the Board has itself a contract with the shipping lines servicing the British market which lays down conditions and rates of freight. Before a freight negotiation begins, the Board has the opportunity to gain some idea of how profitable or unprofitable the previous year's trading has been for the shipping companies. This is of some interest but is not really the fundamental fact in the discussion. The real parameters are that the Board may not beat down the price to a stage where the shipping companies go bankrupt, and the lines may not force the price up so that the farmers go bankrupt.

Sometimes it seems that, from a purely selfish point of view, the Board would be better to leave freight negotiations to Government or some other organization. After all, there is not likely to be any kudos in making agreements which, because of inflation, are almost certain to be more expensive each year. Unfortunately, I cannot believe it would be a good thing for the Board to do this. I am sure the direct representatives of those who are going to pay the price make better bargains than those less directly concerned and who may have other axes to grind.

The prime objection to monopolies is that they give no standard of comparison, so when new trades started to develop around the world, the Board decided to attempt to keep some element of competition in the shipping services. This was possible for the American and Japanese trades because volumes were smaller and regularity of arrival was less important than for the United Kingdom trade. In both the United States and Japan the retail trade is small and the trade in manufacturing meat prodominant. The Board does not have contracts with the lines serving these areas, though it does ensure that the services are fairly well integrated. Actual freight rates are not negotiated, but a close interest is taken in them. The Board welcomes any shipping line that appears and offers (and shows it can produce) a better service or a lower rate or both.

It is interesting that changes in rates over the past ten years have been about the same in the trades where the Board exercises tight control and in those where it tries to maintain as much competition as possible.

DEGREE OF CONTROL OF THE INDUSTRY

The ability to control trading, shipping and licensing has given the Board great influence over the industry. But the original Act of 1921-22 also gave the Board the power to take over all meat and to sell it on behalf of the farmer owners. No Board, so far, has wished to do so but this does not mean that the power has been without very considerable importance.

What successive Boards *have* wished to do, at certain times, is to buy *some* meat for a particular purpose or for sale in a particular market. The Act has been amended at various times to enable this to be done but just as important was, that, in the mid-fifties, the Board acquired a substantial reserve fund.

The first example of the Board's use of these powers (and of the fund) was when it set up the Meat Export Development Company (Devco) to sell lamb in North America. This was at a time when the existing haphazard marketing procedures gave no promise that a substantial market would ever be developed there. Devco has had and probably will continue to have its share of ups and downs. There is, however, little doubt that it has been an advantage to have a substantial volume of lamb taken off the British market. There are now signs that New Zealand is really beginning to develop a market more suitable and more broadly based than in the past.

A more recent example is the Board's entry into the lamb market last season, when it made a profit of some $7 million. On future occasions, however, it may not be so lucky (or skilful) and reserves must be adequate to cover the possibility of losses.

In Chile and Peru, the Board has become the sole prime contractor though it has appointed agents to do the work. When there is only one buyer, a number of sellers can only reduce the price—not raise it.

PROMOTION

One of the Board's very important functions has been the promotion of New Zealand's meat—not only bringing New Zealand lamb to the attention of consumers in a considerable number of countries, but also assisting with marketing and merchandising through programmes designed to help distributors and retailers.

The Board in fact has been in the promotion business since 1922-3 although in the early years it did not advertise or promote in any great depth.

The carcass trade with Britain at that stage was a commodity trade which followed a traditional pattern set by supply and demand. Apart from the United Kingdom, there was really no market of consequence for New Zealand lamb in those days. Even so, the Board did manage to make capital with the name "Canterbury lamb from New Zealand" and "New Zealand lamb" from the 1920s onwards. Lamb competitions and displays at Smithfield made an impression with the British butcher, and the butcher in turn bought the lamb and recommended it to his customers as good buying at a reasonable price.

The whole nature of the promotion operation was transformed, however, when in the middle 1950s the New Zealand lamb industry began to push for a quite rapid diversification of its trade. It became apparent that, in seeking out, penetrating and developing new markets, we had to invest our operation with all the skills of marketing. The Board saw that promotion had to be an integral part of the total marketing strategy.

Despite all the qualities claimed for it, it was apparent that lamb would not sell itself. In the countries of Europe, Southeast Asia, Japan, Canada and the United States, which were to become the new targets in varying degrees of importance, lamb was usually little known and, in some cases, practically unknown. In these countries the empathy of the British market was lacking. By empathy, I mean the sympathetic relationship and understanding that had been generated between New Zealand and Britain through personal ties in the frozen meat trade over 70-odd years. New Zealand suddenly found itself a small trading nation in a big league, having to make its own mark through its own marketing abilities. Somebody was needed to set the priorities for promotion, to set the targets, establish the right techniques in making New Zealand lamb known and in demand in these countries, and also to foot the bill. The Meat Board accepted this responsibility.

It has been a costly and, at times, frustrating enterprise because, frankly, the task has been to promote and market a product that has not been at all popular, compared with the better known meats —beef, pork and poultry. Nevertheless, it is reasonable to say that New Zealand has achieved excellent results. In 1972 more than 60,000 tons of lamb, or nearly one-fifth of the export total, went to markets other than the United Kingdom. This year it is likely an even bigger diversification total will be achieved. In fact, we have been forced to suspend the diversification scheme part-

way through the season, because too much was moving away from Britain.

Drawing from interest in the Meat Industry Reserve Account, the Board has spent in recent years between $2.5 million and $3 million annually on advertising and promotion. It has spread this money across some 17 countries but the main targets, apart from the United Kingdom, have been Europe (mainly Italy, the Netherlands, Switzerland, Greece, West Germany and Belgium), Japan, Canada and the United States. Greece is expected to take about 30,000 tons of our lamb this season and ranks as the market second biggest to the United Kingdom. Next in order of volume come the United States, Japan and Canada. The situation is unique in that the meat producers of New Zealand are financing a promotion campaign for a product they do not own.

Promotion as part of the total marketing function is carried out in many and varied ways according to the nature and development of the market concerned. Advertising and promotion agencies are employed to assist in all the major target countries, and in London, Tokyo and New York the Board has promotion executives who co-ordinate the activities of the agencies. In the United Kingdom, where there is expert knowledge in the handling of frozen lamb, little attention has had to be given to the educational aspects of lamb merchandising. Most of our United Kingdom funds—sometimes considerably in excess of $1 million a year—have been aimed at the consumer. Some of it goes in point-of-sale materials for butcher shops; some goes into full-colour advertisements in certain women's glossy magazines. It is possible to judge the effectiveness of these advertisements by the number of responses they draw from housewives writing in for recipe booklets. Last year alone, more than 200,000 of these booklets were requested.

Television is also used in the United Kingdom in short bursts, and in recent years the budget has been made sufficiently flexible to enable co-operative campaigns with chains and multiples to be run at short notice, according to the need to stimulate the market. This raises the point that the Board does not promote just to move lamb in volume, but has the twin objectives of selling more lamb and at higher prices.

In Europe much of the promotion programme was originally built around trade fairs. This made it possible to get alongside government and trade officials, in the public relations sense, in markets where their co-operation was needed to break down barriers to the access of our lamb. The trade fair policy also let

us radiate our programmes to the trade and general media, to catering industries and to consumers. The fairs were used as a focal point.

Again, the Board is becoming more flexible with its funds, progressively being involved with supermarket chains in merchandising programmes. In Japan, where lamb was hardly known, the attempt was made to give it an image. The approach was made through television, and considerable money was spent over a period of five years, succeeding in the Tokyo area in achieving a 90% awareness of lamb. This awareness has still to be converted into continuing sales at big volume, but lamb sales to Japan this year will be a record — perhaps as high as 8,000 to 9,000 tons.

It must be emphasized that lamb will not sell itself in continuing volume at growing prices. It takes promotion to do this—the use of all the advertising, publicity, public relations and merchandising devices to stimulate the retailer and attract the consumer. The retailer will not go bankrupt without New Zealand lamb and the consumer will not go hungry without it. New Zealand is competing for the housewife's attention and her dollar with not only the many other meat lines available, but with the thousands of other food items.

Undoubtedly, the Board's promotion over the years has contributed greatly to the present financial strength of the industry and to the useful spread of markets. The money spent annually represents only about 1% of the lamb income, or a very small fraction indeed of the total meat income. The potential can be seen in the simple sum that 1% per pound more for lamb would return $7 million more a year.

INDUSTRY CHANGES

In looking to the immediate future and assessing how the best interests of producers can be met, the Board has affirmed that the private enterprise system should remain although with closer controls in some respects. The method it wishes to adopt is to make more meaningful the provisions of meat export licensing. To this end the Board has prepared proposals which it hopes will be accepted by industry and Government.

These matters follow the investigation of lamb marketing carried out by a Board committee in 1972. It was found that the existing licensing provisions are outdated in the context of diversification and the expansion of sales of New Zealand meat in many more countries, and in the face of greater regulation in

international trade. At present, for example, the Board does not have the right to require information from exporters concerning their trading operations, and is thus hampered in carrying out its statutory obligations. There is no provision requiring meat exporters, on a regular basis, to report their activities in various markets, or for an examination by the Board, if thought necessary, of their actions and reasons.

The Board's proposals will discourage or prevent trading of a speculative nature and allow for the orderly development of marketing. They will enable New Zealand to demonstrate to governments, producers and traders in other countries that it can control quality, quantity and the flow of product to their markets. While it recognizes that there are considerable strengths in many aspects of the present system, the Board is confident that these can be retained within the context of its proposals, while some of the main weaknesses should be eliminated.

Some months ago a prominent figure in the meat world accused us of trying to get the best of both worlds and left no doubt that he meant this as a criticism. I am grateful to him for pointing this out, for it is exactly what the Board aims to do and is proud of it; so far as we are concerned, it is a compliment. Our objective is to get the best out of the free enterprise system by encouraging competition both in processing and marketing, but to exercise sufficient control to minimize the inefficiencies which undoubtedly sometimes appear in such a system.

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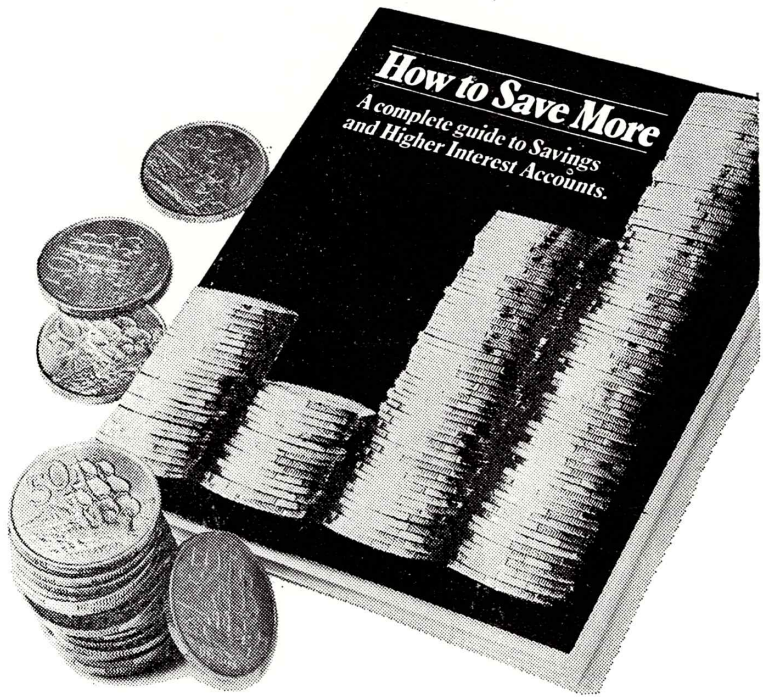

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PASTURE MANAGEMENT AND PRODUCTION

R. W. BROUGHAM*

THIS paper broadly assesses present levels of production for the flat and rolling country and hill country of New Zealand, outlines some of the potential demonstrated for these regions, and, finally, highlights a few major points where the attention of farmers, extension workers and researchers alike could be profitably directed to substantially lift existing demonstrated potentials.

New Zealand has about 33 million acres of land that can be classed as pastoral. In 1969-70 it also had about ¾ million acres in grain crops (600,000), vegetables (86,000) and orchards (28,000), and a further 600,000 acres in greenfeed and root crops for livestock feeding. Interestingly, 90 years ago, in 1882-3, there were nearly ¾ million acres (711,000) of land in wheat and oats, an acreage that was slightly exceeded for wheat, oats and barley in 1932-3 (754,000 acres), *i.e.,* 40 years ago. From this breakdown it can be seen that more than 95% of farmed land is devoted to pastoral farming, nearly two-thirds of which is in sown pasture, the remainder being mostly tussock grasslands.

The 33 million acres of pastoral land can be divided into four main categories:

(1) Flat and rolling country

(2) Hill country (both wet and dry)

(3) High country

(4) Warm temperate regions (a special category embracing some of the flat and rolling country and hill country in the first two categories).

These categories are based in the broadest sense on pasture type, determined mainly by climate, especially temperature and rainfall, and farming pattern.

FLAT AND ROLLING COUNTRY

It is estimated that flat and rolling pastoral country represents about 10 million acres, which supports about 62 million ewe equivalents. This is a carrying capacity of something close to 6.2 ewe equivalents (EE) per acre.

*Grasslands Division, DSIR, Palmerston North.

The average amount of dry matter (DM) consumed by the animals each year from each of these 10 million acres is about 7,000 lb.

Average carrying capacities for counties such as Southland, Ashburton, Egmont, and the Waikato, vary only slightly. Each is roughly 6 EE an acre in spite of differences in farming patterns.

Within this type of country, highest recorded carrying capacities and yields have been two cows per acre, 500 lb of butterfat per acre (factory returns) as a self-contained unit, 10 to 11 EE per acre, and in excess of 900 lb net of meat per acre from dairy beef, again on a self-contained basis. Converted to EEs, these figures in each case represent carrying capacities of between 10 and 15 per acre. The fact that figures such as these have been obtained in Southland, the Manawatu, Taranaki and the Waikato indicates that most of the 10 million acres in these regions have a potential to carry and sustain about twice as many animals as they presently support.

These figures line up very well with pasture production data that have been obtained in these areas. Yields of between 12 and 15,000 lb DM per acre are regularly recorded. These yields come from pastures that are made up of ryegrasses, cocksfoot, Yorkshire fog, browntop, *Poa trivialis*, sweet vernal, timothy, white, red and suckling clover, and lucerne, and in many cases flat weeds and other less productive species.

Further increases in productivity are well within the scope of present pasture species that will grow in these areas. If full attention were paid to four major factors which, in my view, are the major limits to increased pasture and animal productivity in New Zealand production could be markedly lifted. The four factors are the photosynthesis process; the fertility cycle associated with fertilizer practice; pasture utilization; and pasture pests, insects and plant diseases.

Photosynthesis Process

Figure 1 is a diagrammatic representation of the photosynthesis process, the process that converts light energy into elaborated plant compounds by combining carbon dioxide and water. It is markedly dependent on temperature, requires nutrients, and can proceed only in the green chlorophyll-bearing parts of plants. It also provides all energy for other plant processes such as nitrogen fixation, nutrient uptake, tillering, leaf growth and reproductive growth through the energy released by the respiration of elaborated plant compounds.

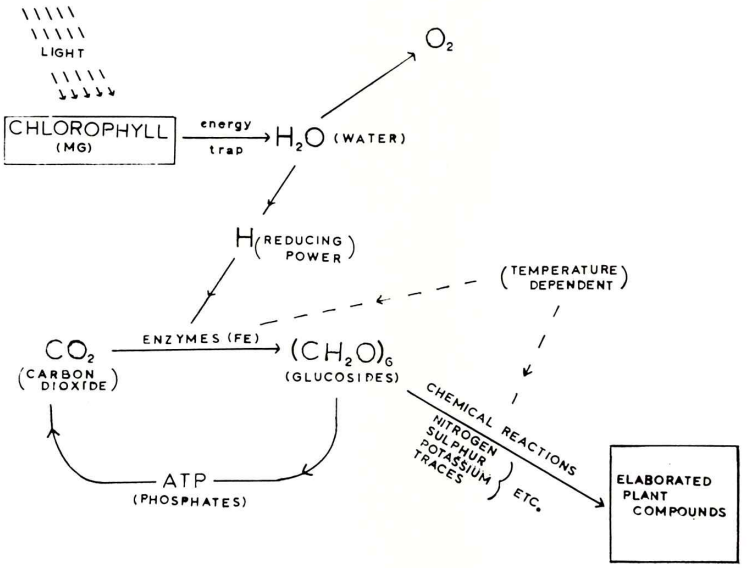

FIG. 1: *Diagrammatic representation of some of the photosynthetic reactions.*

It is not generally realized that whenever pasture is grazed, fertilized or cut, the process of photosynthesis is markedly influenced. This is shown in Table 1, where a ryegrass and white clover pasture was cut to three different heights and regrowth measured.

TABLE 1: FOURTEEN DAYS' REGROWTH FOLLOWING CUTTING TO TWO HEIGHTS IN SPRING

Cutting Treatment	*Yield (lb DM/ac)*
1 layer of leaves left	480
Enough leaf left to fully use most light	1,185

In the first 14 days of regrowth, approximately twice as much DM was produced from the pasture that was cut to leave a cover of leaves sufficient to trap all the light energy that the species present in the pasture were capable of using.

Because the photosynthesis process is also temperature dependent, and because different pasture species have different temperature optima, the species dominant in pastures at different times of the year will markedly influence the amount of growth obtained. A very good example of this is the summer browntop

dominance that occurs on much hill country. Not nearly enough is known about the management principles involved in controlling this very unpalatable growth to allow species such as white clover and the ryegrasses or cocksfoot to utilize more light energy and thus produce more animal feed. With the necessary information, it would be possible to maintain better photosynthesis.

The Fertility Cycle and Associated Fertilizer Practice

The thesis of those like Sir E. Bruce Levy and the late Dr P. D. Sears of the clover plant-fertilizer-dung and urine return, and the effect of these on pasture composition and productivity, and hence animal production levels, was never more needed than now, especially on those areas of flat and rolling country producing less than half their potential, and on nearly all hill country.

There are still large areas of New Zealand where legume growth is well below its potential with a very poor seasonal spread, where imbalance between grasses and legumes means waste of the cheapest form of nitrogen possible (that obtained from clover nodules), and where bag nitrogen, instead of being used in a supplementary role, is used to make up for the deficits of clover nitrogen brought about by poor management practices. We seem also to frequently forget the very high nutritive value of white clover and the contribution this plant can make in pastoral agriculture solely as an animal feed.

Recent research is providing a better understanding of the nitrogen-fixing process of legumes. It is indicating, for instance, that the process will stop when bagged nitrogen is applied in some situations, and the clover plant itself starts using some of the applied nitrogen. It also indicates that the nitrogen-fixing process is influenced markedly by a wide range of management and environmental factors. Because of this, much more needs to be known about this process and its interaction under different grazing patterns or farming systems. We must relate these findings to aspects of the fertility cycle and fertilizer practice, and assess them in relation to pasture and animal production.

There must also be a much better understanding of the utilization by pasture plants of nutrients applied as fertilizer. What do we really know of the agronomic implications of phosphate fixation by soils? And this when our annual superphosphate bill is greater than $50 million a year.

PASTURE UTILIZATION

From the discussion so far, it should be obvious that production and utilization of feed produced from pastures over considerable areas of New Zealand's pastoral lands is very poor. They amount to less than half the DM capable of being produced on flat and rolling country and less than one-quarter of that capable of being produced on most hill country. They suggest that studies based around better utilization of feed produced on farms should be our most immediate and rewarding. As previously stated, such studies must embrace management systems where better control of stock pressures is obtained, where soils are better drained so that feed wastage from stock puddling and fouling is minimized, and where over-grazing is avoided.

Over the past few years I have been appalled at the amount of over-grazing that occurs during the summer throughout New Zealand, especially at higher stocking rates, under the guise of better utilization. Figure 2 illustrates this point. It shows the cumulative effects of only three hard grazings over the summer months on subsequent pasture productivity. If full use is to be made of pastures during the summer and thus subsequent production enhanced, such effects must be avoided.

I also wonder whether farming systems have become much too stereotyped. Every time I visit Southland during the summer months, or walk over our wetter hill country at the same time of the year, I am staggered at the tremendous wastage of feed that

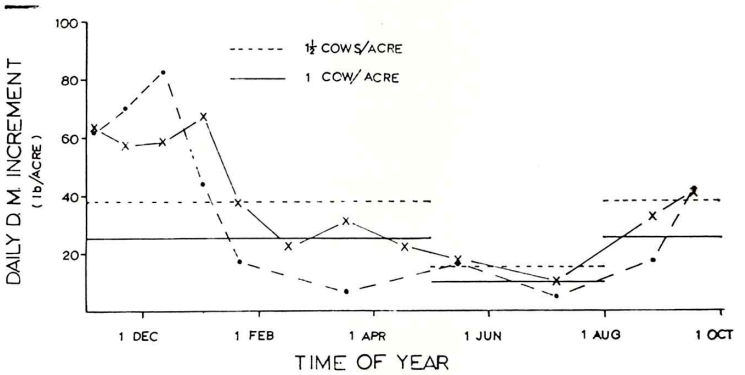

FIG. 2: *Pasture production following hard and lax grazings over the summer period.*

(●— — —● represents summer hard grazing treatment;
x ——— x represents summer lax grazing treatment.)

regularly occurs. In Southland, farmers attempt to conserve, as hay or silage, as much of this summer surplus as possible, even to making hay into the wetter autumn months, whereas on the wetter hill country the browntop runs rampant. This is ideal management for browntop, and, while present attitudes persist, there is little likelihood that the more productive ryegrasses and clovers will be encouraged. For these areas, and others such as the warm temperate regions where good winter production can be obtained, I wonder that lambing and calving times cannot be adjusted to better fit seasonal trends in pasture production. These suggestions should at least be tried on an experimental basis. What is so magical about late winter-early spring lambing or calving that it must be applied over the length and breadth of New Zealand, regardless of differences in seasonal spread of production in different regions? In my experience, pasture does not show the same seasonal pattern of production in Kaikohe compared with Southland, or on the dry Canterbury plains compared with the wet West Coast hill country of the North Island.

Pasture Pests, Insects and Plant Diseases

There are reliable farmer estimates of pasture pests such as Australian soldier fly, black beetle, porina caterpillar and grass grub cutting 25% or more from production levels, especially at higher stocking rates. These pests occur throughout most of the regions of New Zealand. Yet I know of two farmers who have had to raise finance themselves to help obtain increased research into these farming problems. Is this good enough in a country where more than 90% of export earnings are currently being obtained from primary production? Surely where problems can be shown to be of this magnitude, there is ample justification for a concerted research effort.

I had listed a fifth point in this section, that of incentives. None of the above will come about in the foreseeable future unless adequate incentives are available to those responsible for the improvements.

HILL COUNTRY (BOTH WET AND DRY)

Statistics indicate that there are about 11 million acres of hill country in New Zealand that support about 31 million EE, an average carrying capacity of about 2.8 EE per acre. The average amount of DM consumed by the animals each year from each of these 11 million acres is about 3,000 lb.

For this type of country, the highest recorded carrying capacities have been 8 to 9 EE per acre, or 1½ to 2 cattle beasts per acre. These figures compare with recorded pasture production levels of up to 20,000 lb DM per acre at stock camps, 10 to 12,000 lb DM per acre on wet hill faces, and 1 to 8,000 lb DM per acre on dry hill faces (Suckling, 1956). Pasture composition usually ranges from browntop dominance to danthonia dominance.

A typical example of the improvements possible on this type of country is shown in Table 2. By the use of fertilizer, mown herbage yields have improved by a factor of 5, and botanical composition has improved dramatically.

TABLE 2: YIELDS (LB DM/ACRE/ANNUM) OBTAINED FROM RUN OUT HILL COUNTRY PASTURE FOLLOWING APPLICATIONS OF PHOSPHATE AND NITROGEN*

Treatment†		
Phosphorus Applied (lb/ac)	*Nitrogen Applied (lb/ac)*	*Total Yield (lb DM/ac/an)*
0	0	3,000
15	0	5,500
60	0	11,000
60	800	15,000

*D. A. Grant, Grasslands Division, DSIR, Palmerston North unpublished data.

†The fertilizers were applied regularly throughout the year. The figures shown are the annual totals applied.

The figures in Table 2 indicate that hill country regions are grossly underfarmed. There is an existing potential to increase carrying capacities by a factor of at least 3 by removing phosphate limitations, and, in time, by much more through the return of dung and urine. If dramatic increases such as these are to be achieved, however, there will need to be some drastic changes in outlook by those involved in hill country farming.

First there is the need to better control stock pressures in much the same way as occurs on flat land. Utilization of feed produced on most hill country is poor, and unless stock pressures are better controlled it will remain so.

Secondly there is the need to markedly improve the fertility cycle in hill country pasture ecosystems. Some improvement will come about by better control of stock pressures, but it will also be necessary to become much more aware of the part legumes play in the nitrogen cycle; of the movement of fertility by stock through dung and urine, and the effect of this on pasture productivity; of

the detrimental effect that uncontrolled stock pressures can have on legume growth, and of the significance of topography in the fertility cycle.

Thirdly there is the need to improve the nutritive value of herbage produced on hill country, and especially on the harder hill country. This will be aided by improvements in soil fertility through the better growth of legumes and by better control of stock pressures. However, better control of summer browntop dominance through altered management systems will also be required.

None of these factors will be improved substantially over large areas of hill country unless present attitudes of farmers, researchers, and policymakers change. The extensive nature of hill country farming is too much a function of tradition. In my view, it is also too much a function of lack of interest by policymakers. For instance, I know of only two hill country pastoral research workers who can devote their full time and energies into researching hill country farming problems. Yet the New Zealand maize crop, which this year will be worth about 1/200th of the New Zealand hill country pastoral crop, must have 5 or 6 full-time researchers involved in its welfare. I do not decry this effort but I am appalled at the apparent lack of interest in hill country pastoral research.

Much more research is required on the 11 million acres of New Zealand hill country—even "way-out" research. Why lamb in September when there is more than ample feed on much of the hill country during summer? Why not some electronic device that controls and confines animals through a noise barrier or something similar? Or other forms of stock control? Surely technological knowledge of controlling stock has not been exhausted? How much research is being undertaken on better and more complete forms of fertilizer—possibly more concentrated, to reduce application costs on a given area? How much is known about time of application of various fertilizers in relation to topography and, say, rainfall patterns? What is known of return patterns of dung and urine on hill country in relation to grazing pattern or to subdivision? Studies such as these must surely form the basis of subdivision patterns for the hills. Does anyone really know whether fertilizer applied to the hills is a source of pollution as the environmentalists would have us believe? If it is, and this has yet to be shown, then is there not a need for pastoral studies designed to prevent nutrient run-off through management and pasture cover?

Some of the answers could demand completely new outlooks on hill country farming. At the same time they could make New Zealand's hill country just as productive, or even more so, because of better rainfall patterns, as the flat and rolling country of New Zealand.

What has been attempted in this paper is an assessment of progress in terms of feed produced from pastures for feeding livestock on the flat, rolling and hill country of New Zealand. I hope it has also been demonstrated that there is still a long way to go before New Zealand farming expresses the full genetic potential of the different pasture species presently available for use by farmers. As efficiency levels rise (and hopefully incentives and manpower will be provided to farmers to allow them to achieve these), I am sure research effort will make available to pastoral farming improved varieties of pasture plants, associated with more sophisticated farming methods and management systems, that will allow the full genetic potential of these to be expressed. However, this will be achieved only with an optimistic outlook, one that puts into perspective those statements suggesting that, for considerable areas of New Zealand, some pastoral farming activities are outmoded. I suggest that in 20 or 30 years' time, today's younger farmers will still be hearing the proposition that pastoral farming production can be doubled, even though levels of pasture and animal production will probably be twice as high as they are today.

REFERENCE

Suckling, F. E. T. (1956): *N.Z. Jl agric Res. 2:* 488-543.

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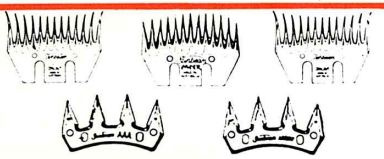

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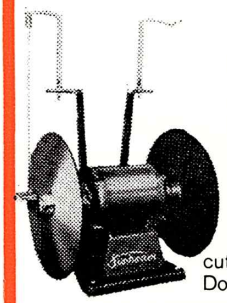

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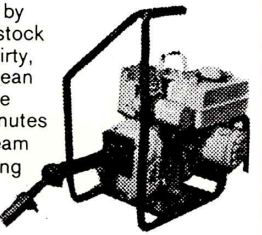

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SHEARING GEAR A GILT-EDGED INVESTMENT

THE NEW ZEALAND WOOL CLIP AND THE FUTURE

JOHN CLARKE*

WORLD TRENDS

EVERYONE is interested in wool prospects, and there is a common notion that prices are at present abnormally high. What has happened in the past 12 months is that textiles have emerged from a prolonged period of depression and have regained their status with other commodities.

This is shown by the index of world commodity prices published in the London *Economist*. The index is based on 1963, which is 100. For all commodities, it now stands at about 220, an increase of 71% in the past year. Fibres stand at about 199, somewhat below the average, but they have risen more rapidly—92% in the past year. Wool has risen even faster for various reasons—a shortage of supply, a specific demand and the influence of auction. The index shows that present fibre prices are not unreasonable and are capable of being sustained. However, wool's ability to maintain its position will depend on how effectively it is marketed and promoted.

The contraction in world supply of wool is the first in half a century that has occurred for reasons other than weather conditions. Many growers last year were reducing their involvement in wool or discontinuing it altogether. In Australia, sheep numbers at March this year were down more than 20 million, from 162.9 to 142.3. This is 12½% and equivalent to one-third of the New Zealand flock.

The Japanese foresaw the shortage and it was they who hunted up prices to ensure supplies for their mills. But there has been a great increase in demand for wool—a change in consumer preferences. The International Wool Secretariat (IWS) has played its part in this, as shown by the 28% increase in the sales of Woolmark labels during the year, quite apart from the development of the Woolblendmark campaign.

The prospects in New Zealand's major consumer markets as seen by the IWS are for continued economic growth and a strong demand for wool-type goods for the rest of the year. Beyond

*Chairman, New Zealand Wool Board.

that, there are some uncertainties from the currency situation and the possible effects of higher prices at the retail counter. Wool prices are well above synthetics and, although the latter are rising, the gap is going to remain large and competition will remain strong. There is not likely to be any great change in the volume of wool coming on to the market in the next year or so; in fact, some Australian estimates are for a further run down in supplies. The outlook, therefore, is encouraging, and provides a good climate for the Wool Marketing Corporation beginning its operations. The main danger is that people will underrate the serious task that confronts the Corporation.

THREAT OF SYNTHETICS

The Battelle Memorial Institute, which examined our markets in 1971, concluded that New Zealand wool is severely threatened in its marketplace, that the manner in which the wool is marketed inhibits response to that threat, and that strong changes are needed to make wool more competitive. Those findings are just as true today—in fact more so because of the way in which runaway prices have hurt many wool customers.

Derek Damerell, the regional director of the IWS in America, recently spoke to growers in New Zealand about the problems which fluctuating prices of wool cause to manufacturers of carpets, hand knitting yarns and other woollen goods where the raw material cost component is high.

One man described him as a prophet of doom, who ought to be disregarded. After all, look at the prices farmers are receiving. The world's population is growing, oil supplies are going to run out by the end of the century and everybody is looking for products that are not made in a cloud of pollution. This is the prophet of prosperity speaking. It is a far more dangerous stance to take because it encourages complacency and postpones reforms until, perhaps, too late.

Both positions oversimplify a very complicated picture. We should forget about prophecy and recognize that our future will be what we make it. This will depend on how honestly we view our situation and the skills we show in turning it to advantage.

MARKET CHANGES

By comparison with past times, all markets in Europe, the United States, Russia, Japan, are changing very rapidly. There

are obviously many ways in which they can develop, affected by population movements, the advance of technology, wars, economic trends and the sweeping changes in thought and life-styles that have been brought about by television, travel and other forms of communication.

It is intriguing to look ahead and speculate about the shape of the textile industry in 25 years or so. Recent talks with manufacturers and others around the world have encouraged me to do this. As I see it, basic textiles—most of them synthetics—will be produced in quantity in the low-cost countries, sufficient to meet all the world's needs. In practical terms, many will be adequate substitutes for wool. Wool, the "real thing", will be sold mainly on its fashion content, its aesthetic appeal, prestige and exclusiveness. It will be expensive because of the cost of growing it and the greater complexity of processing it. Only a small sector of the world's population will be able to afford it, but that market will number many millions.

Manufacture of wool will be in the hands of relatively few large concerns, able to keep costs of processing down by handling large volumes. At the same time, advances in technology will enable them to produce a great variety of fashion lines. Competition will be strong, and expenditure on advertising and marketing will probably match that for cosmetics.

Trade with these companies seems likely to be more stable for the woolgrowers than New Zealand wool marketing is today. Communications with such companies should be much closer. Contracts are likely to cover technical service, promotion and so on. Specifications based on objective measurement will be well established.

Karastan Rug Mills of the United States, whose president, Walter Guinan, was in New Zealand recently, is an example of the kind of company under discussion. Karastan is selling expensive wool rugs of the highest quality. It is at the top of an industry almost dominated by synthetics, but it has a large and growing market among America's affluent class. It is big and advanced, both in marketing and technology.

This view of the future will be astray in places but the essential point remains: there are several distinct types of market and a variety of end uses, and the whole situation will change markedly in the next few years. This is what confronts us and we must be organized to cope with it.

WOOL IN THE UNITED STATES

The number of wool carpet lines now on the market in the United States is fewer than half what it was in early 1972. The sudden high prices of 1963 cut wool consumption in half and the loss has never been regained. It is very possible that this boom could kill the market altogether. Of course, crossbred wool is being sold elsewhere, and sold at high prices. As Mr Damerell says, much of it appears to be going into women's woven apparel, partly because there is a shortage of Merino wools, and partly because it is a cheaper wool that helps to keep down the final manufactured price. His argument is that carpets, although they may pay a somewhat lower price, represent a steady trade for New Zealand. The apparel uses are fine today but may not be easily maintained tomorrow. He argues that if growers turn away from the carpet market, it should be a deliberate policy decision, not just the effect of a price change.

These are decisions that must be faced; in other words, New Zealand has to start selling wool—not merely continue to offer it for sale as in the past. From all over the world, the Wool Board has been receiving reports of the reaction of important customers to the rise in wool prices. In France, Italy, the United States, their feelings are very much the same. The prices are pushing them to the top of the market, to greater isolation and greater risk.

It may be said that the price, after all, is their affair, but of course the individual manufacturer cannot determine the general price. Moreover, many of them are nervous because they are becoming heavily committed to expensive merchandise which has not yet been tested at the retail counters. They are afraid that when that happens, in late 1973 or early 1974, there may be a reaction which will leave them with overpriced stocks. It is to guard against this that the IWS is currently putting all the weight it can into retail promotion programmes.

If the merchandise sells, it will be a happy day for everyone because it will demonstrate that wool really can hold a big premium over synthetics. There will be renewed confidence in the trade and the continuance of sound prices may be effected into the 1974-5 season. Mr Damerell is confident it will happen and hopefully it will. All round the world there are clear indications that manufacturers want greater stability in prices, and they are looking to growers to do something about it.

PRICE STABILIZATION

Reference has been made to the views of Karastan and other carpet makers. In Italy, Dr Angelo Zegna, whose group uses 10,000 bales of apparel wools, mainly for the men's suiting trade, told the IWS that it is necessary "to find a formula to stabilize prices—that's what matters". One of the most successful blanket manufacturers says that raw material represents 40% of his costs. Along with soaring labour costs, the price of wool is going to put his prices up 20% this year. Manufacturers like this one want to be able to trust the stability of prices before they invest heavily in wool.

Most remarkable of all, the President of the International Wool Textile Organization, M. Georges Peltzer, spoke recently in favour of some fixed price system to growers that would stimulate confidence and production. He said that in its anxiety to ensure access to supplies and through fear of competition from synthetics, the textile industry had neglected the need for woolgrowers to operate profitably enough to improve the quality and expand the volume of their production. On the other hand, runaway price movements trigger off a process of substituting synthetics for wool, and installing synthetic fibre plant. "The long-term interest of both the grower and the industry," M. Peltzer said, "demands a development of the supply and availability of wool to prevent these runaway price movements and avoid this mechanism of substitution."

The essential point is that the industry expects the initiative in this to come from us. It is now much easier to lose customers than to hold them. If we indicate indifference, either by words or policies, we can only expect to drop markets. As can be seen over the past six years, regaining markets is slow, difficult and costly.

PRACTICAL STEPS

We must support promotion, research and technical development. The International Wool Textile Organization apparently credits the IWS and the Woolmark campaign with a major part in lifting wool out of the recent depression, and at its May meeting the organization's conference voted for an inquiry to verify this. A successful promotion effort now will assist stability by gaining acceptance for the higher retail prices.

In marketing itself, better communications, larger lot sizes, objective measurement, new variants on the auction system—such as having wool on continuous offer—all these things can help

stability. Greater stability means not only better trading conditions for wool processors, but better management of farms, of the IWS, and all other services. At present, for instance, growers lose when market fluctuations wipe out technical and promotion efforts. Mr Damerell gives an example of a campaign in the United States, for machine-washable hand-knitting yarn, cut by high wool prices from 10 million pounds of wools to half-a-million pounds.

What about deliberate action to stabilize prices to certain customers or classes of customers? There are the carpet makers, whose raw material costs represent a large proportion of the whole and whose prices are often set for 12 months in advance. A strong movement in raw material costs creates problems for them. With the co-operation of the wool export trade, it should be possible to take steps to improve the situation.

The IWS sees this change in marketing as highly important for the United States. In my judgement, we should be extremely careful about turning our back on the wealthiest consumer market in the world. Carpet wool is in difficulties there at present, but, with proper marketing strategies, it could be maintained and strengthened. Our promotion staff is doing a good job, but needs marketing support.

We should be aware of the factors that make the United States situation so difficult. One is that production is usually through large organizations, whose main concern is profitable operation regardless of the fibre used. The same trend can be seen in Germany and the United Kingdom; it is going on all round the world. In New Zealand takeovers and amalgamations are occurring. Generally, the bigger the organization, the more top management is likely to make fibre-buying decisions on the simple criteria of convenience and profitability. New Zealand has to market its wool in ways that meet those criteria.

There is also the point that, if the carpet market is neglected, large volumes of crossbred wool must be absorbed in other end uses. That appears to be happening satisfactorily at present, but, when supply exceeds demand, it would be undesirable to have reduced the outlets for New Zealand wool. It is very fortunate that growing demand from Eastern Europe over recent years absorbed the wool dropped by the American carpet industry after the 1963-4 boom.

LOCAL MANUFACTURE

The Hon. W. E. Rowling, in the 1973 Budget, announced more export incentives for industry, and it is to be hoped that these will encourage further processing of New Zealand wool. There are many marketing problems—from tariff barriers to consumer research—but they can be surmounted. The wool is here; there is a growing population to be employed, and the incentive to make the most of national resources.

Mention has been made of how the scouring industry and carpet manufacturing have both developed, and there are other promising fields, provided the climate is attractive to industry and trouble with international trade regulations can be avoided. In fact, in view of the way the textile industry is developing in some parts of the world, further processing may well be required.

The three main partners in the IWS, Australia, New Zealand and South Africa, provide the great bulk of wool going into free world trade. Joint efforts in promotion and research have proved most effective. It is essential to maintain that joint approach and extend it into other areas of activity as the marketing organizations develop. Collectively, these nations are the marketers of a vast volume of a premium-quality fibre and they should have a strong liaison with one organization, the IWS, handling many aspects of research and development, overall promotion, licensing, tariff matters and industry negotiations. United, they can greatly simplify many of the complexities of marketing and reduce the fluctuations of price and supply. These cause so many difficulties for customers, and reduce the effectiveness of many research and promotion activities.

The argument so far has maintained that wool should be sold for a number of end uses and in a number of markets. The markets are rather different in character and they are all changing. One or two end uses, notably carpets, have good growth potential. Others may pay better prices but are likely to evaporate. Still others deserve cultivation. These are considerations which in the past it has been possible to ignore. It is no longer possible because there are substitutes, and the very action of the current marketing system is sending some customers post-haste to those substitutes.

MARKETING CORPORATION

If opportunities are to be exploited, methods of marketing will have to be very flexible; what is needed is an organization that is quick on its feet. This imposes right away a responsibility on the

woolgrowers because they control the Marketing Corporation. It will be responsive to the mood of the growers. To gain most benefit from the Corporation, we must be liberal in our outlook towards it and prepared to give it the greatest freedom of action.

To those who have opposed the wide powers of the Corporation, I would say the essential point is its objective: to secure in the interests of growers the best long-term returns for New Zealand wool, by developing marketing systems that suit customers, by meeting the competition of other fibres and by cutting marketing costs. The objective is a very comprehensive one, but after long study it was decided that it was the only one that honestly faces up to wool's situation. It was necessary to ensure the Corporation had the powers to fulfil the objective. They are wide powers, but they are not there to bludgeon the growers; they are there in the growers' hands to carry through the reforms which will, in the words of the objective, secure the best returns to him in the long term.

The powers are there but the way in which they may be used is entirely flexible. The Corporation is launching the voluntary pooling of designated types, with the compulsory pooling of skirtings and oddments. It has yet to be seen how beneficial this arrangement will prove, before deciding on the next step. The introduction of measurement and sample selling will be another factor that will influence the organization of marketing—and also growers' views on individual selling. And so it will go on, closely watched by growers. If one procedure looks unsatisfactory and the growers wish to change it, the Board and the Corporation will soon know through the Electoral Committee.

This is what grower control means. The Wool Marketing Corporation is an instrument that has been placed in the growers' hands. The growers should now demonstrate to the country and to the world trade that they can use this instrument wisely and courageously for the improvement of wool marketing. They deny themselves and the industry if for one reason or another they do not use it as they should.

THE WOOLGROWER

How does the grower think the Wool Board should proceed; how well does the Board know the grower's mind; how well are the Board and the Corporation going to communicate with the grower in future?

It goes without saying that the Board misjudged the situation last year in respect to acquisition of the wool clip, and I think this was understandable. For years we had pushed on with marketing investigations and had put out a number of reports which advocated or approved schemes involving acquisition. There had hardly been a word of protest; in fact, we were being pushed to get on with the job.

We overlooked the fact that there were a great many farmers who had not followed the investigations. Once a firm proposal was made, many showed they were not prepared to support it—certainly not in the very favourable market conditions of the time. The Board stood by the plan because our investigations had led to the inescapable conclusion that it was right and necessary to protect the grower and his markets. I believe time and events will show it was the right decision.

At the same time, the Board has learned a lesson and is giving more attention to communication with growers. The Corporation has in Wilson Whineray a man who will develop a good relationship, and each step in marketing reform will be clearly and fully explained.

New Zealand produces on average about 5,000 bales of wool a day, and almost all that wool is used by industries on the other side of the world. The Board's job is to find out from these industries the best way to supply them, and then organize ways to do it. It is really a servicing operation, and that is what the woolgrowers require. Observations overseas have reinforced my view that in this servicing we must make use of the present trade resources. At the same time, all facets of handling and movement of wool must be improved.

What growers want now is to see the Corporation make a start. If our resources are rightly used, the opportunities for the New Zealand wool industry are enormous.

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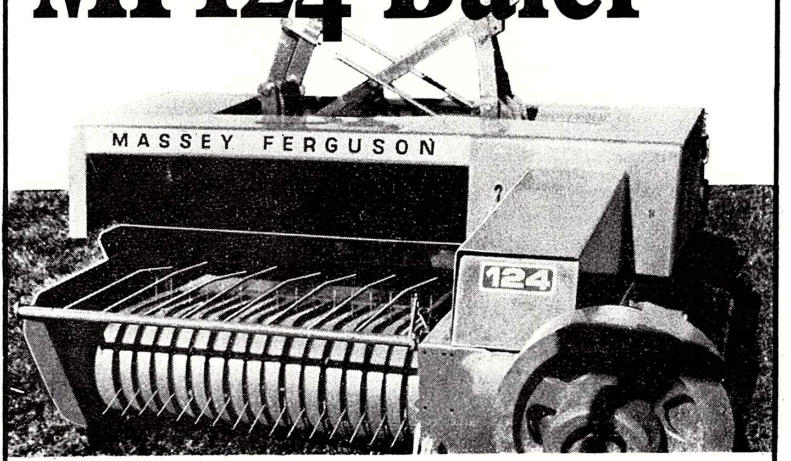

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STREAMLINING SPRING WORK ON THE FARM

GRAHAM RAMSDEN*

THERE are different ways of streamlining spring farm work. A farmer may simply reduce his stock numbers, alter his ratio of sheep to cattle, or employ extra labour. We have chosen to simplify and, in some cases, change well-used traditional methods in order to adjust to the pressures of increasing stock numbers and the cost-price squeeze of recent years. In doing this many ideas have been copied and adapted from other farmers, and it is hoped that any useful points made here will be taken more as a basis for general discussion than as firm guidelines for efficiency.

Differences in farm contour can alter management methods. Difficult access and consequent lack of mobility have been restricting factors in getting farm work done. A lambing beat which involves four to five hours of horse-riding does not leave much time to attend to trouble, and is hard to justify economically. But with the recent purchase of easier country and a number of changes in the farming system, we aim to concentrate our efforts where, hopefully, they will give the best return.

The farm is now running 4.6 ewe equivalents (EE) an acre and with additions it comprises some 2,400 acres. Of this about 1,750 acres are steep hills, the balance being easier with some flats. Most of it is not suited to diversification from mainly sheep and cattle. Thus, twelve years ago when my brother and I assumed control, we decided that the best prospect was to develop the place progressively to its full potential, while also expanding into further land when the opportunity occurred.

As labour is the biggest single expense, it was decided that, while stock numbers increased, we would maintain the same labour input and find ways of either eliminating or streamlining jobs which did not affect stock performance. In the event, this seems to have been successful. In 1960 there was a permanent staff of three, running 3,700 EE, which is equal to 1,200 stock units per man. Today the staff is the same and stock numbers are up to 9,800 EE. This means that the ratio is now 3,270 EE per man or over 4,000 if allowance is made for the fact that about half my time is now involved in management rather than routine

*"Aototara", Woodville.

work. We also do much of our own maintenance work and are still involved in the development programme. In addition, a performance-recorded ram breeding flock of 300 ewes has been introduced and this takes up more time.

IMPROVED LAYOUT AND AMENITIES

Simplifying spring work is really tied to the year-round operation of the farm. Farmers know the pressures which build up in spring and the effort made to get all seasonal jobs done on time. The planning for this must be done the preceding autumn. Much depends, too, on thought given to improving farm layout and providing necessary amenities. With stock numbers increasing rapidly, we quickly became aware of the time spent moving stock long distances to yards, and the physical problems involved with large mobs on steep country. An essential part of the development programme was to overcome these problems if we were to cope with the work. Yards were sited adjacent to as many paddocks as possible, making the mustering for lambing, docking, and drenching easier. Stock races were built to cover the main stock access routes. Today there are two main sets of yards and four satellite ones equipped for any job in all weathers, as well as a main central race and two smaller ones.

The old four-stand woolshed soon became inadequate and was altered to provide two extra stands, a raised board, and more night pens. This was done mainly to enable increased throughput, but it has been a big factor in enabling us to introduce double shearing, and simplify the seasonal work programme. A dual-purpose shower dip built for one-man operation and concrete yards completed the reorganized facilities.

STOCK HANDLING

SHEEP

The stock wintered now comprise 9,000 Romney sheep (6,000 ewes) and 500 cattle (250 breeding cows). Apart from the streamlining of stock handling made possible by the improved facilities referred to, the most notable contributions to labour-saving have come from double shearing, no shepherding at lambing (free lambing), and the virtual elimination of crutching, dagging and footrotting. Since these are all interrelated it is perhaps best to discuss them within the context of the sequence of seasonal operations starting at tupping.

Rams are joined with the ewes on or about March 10, following the introduction of teasers in February to start the ewes cycling. This is earlier than is usual in the district and the purpose is two-fold: (1) It enables the ewes to be settled in lamb early so that they are not disturbed by mustering for second shearing; and (2) With lambing over earlier, there is more time for docking and other spring work.

Second shearing of all ewes takes place in mid-April and, at the same time, rams are harnessed so that the raddled ewes together with the rams can be taken out at dipping near the end of May. Depending on the numbers available the raddled ewes are either sold or kept separate and all their lambs marked as wethers. The ewes are then gradually set-stocked as winter advances, and are drenched and inoculated prior to lambing.

With second shearing in April it is possible to do without the winter crutching of ewes, although it is still necessary to crutch the hoggets in July so as to eliminate dagging before they are shorn in October. The saving in not crutching the ewes goes some distance towards offsetting the cost of the second shearing. Also it saves considerable time and the frustration of being held up by the weather at crutching time. Second shearing also has the advantages that it saves considerable time in shepherding for cast sheep, ewes do better, there are lower losses, and it contributes towards making it possible to eliminate shepherding at lambing.

In fact, now only the two-tooths and the performance-recorded sheep are shepherded at lambing; the latter for tagging purposes only. We have been working towards this free-lambing situation over the past five years. One problem was that we could not buy the type of Romney ram we wanted. To overcome this, a small ram-breeding flock has been selected from ewes on the farm—those with open faces, sound feet, evenness of wool and size. These are mated to carefully-selected "Marshall Romney"-type rams. The results are very promising, not only in lambing percentage and providing ram replacements, but also in giving a surplus for private sale.

Before double shearing and free lambing were introduced, a careful analysis was made at lambing of the costs and payoff, if any, from shepherding the ewes. It indicated that at this time, on the hills, the number of lambs saved barely paid for the shepherds' wages. There was, of course, the problem of cast ewes, but the introduction of second shearing largely overcame this as already mentioned. With no crutching it was thought there would

be trouble at lambing with lambs finding difficulty in suckling. However, we tried the system and there appears to be no significant problem in this respect.

Of all farm jobs, the most time-consuming for the least reward is dagging. This district seems to be an extra good dag-growing one, and when a month is spent dagging for shearing a man really starts complaining about being short-staffed. It also tends to stimulate the mental processes in spite of the physical exhaustion. It soon became clear that if dagging was to be eliminated it would be necessary to shear earlier, starting in the second week of November, shearing and weaning the lambs at the same time. This timing is, obviously, tied to second shearing, the elimination of crutching, earlier lambing, the onset of fly-strike, and the need to shear before the ewes and lambs become too dirty.

There are of course still dags to deal with, so the lambs are shorn first, while, to let the dags dry, the ewes are shut in a bare paddock with plenty of drinking water. This drying of the dags before shearing takes approximately 48 hours. The worst of the daggy ewes are then drafted off and these are shorn by the contractor at a slightly higher cost. The other ewes go through in the usual way and it has been pleasing to find there is now less "pen stain" than there used to be with the old method. It will be appreciated that the raised shearing board is a considerable help; without it the operation would be very costly and labour involvement much greater.

CATTLE

With heavier stocking some of the time saved through streamlining the lambing process is now spent with the cattle. As with other farms, the management of cows close to calving under the old free-range system has become almost impossible through lack of roughage. Selected paddocks are shut up in April for use at calving. Cows go into these paddocks just before calving at 1¼ to 1½ to the acre, and, if possible, they are kept there until mating starts. Heifers are mated to calve as two-year olds and they require closer supervision. All cattle are dipped, the younger ones being drenched as well.

Although a reserve of hay is kept, it is not normal practice to feed large quantities to the cattle because of the high cost of materials and the labour involved. However, controlled roadside grazing within an electric fence is used in the late winter if necessary. This can be done for about one-tenth the cost of feeding

hay. We are also experimenting with special measures to give extra grass growth through the critical early spring period.

The new system of cattle management allows earlier calving (August-September) with obvious advantages for the calves. Calving percentages have gone up nearly 20% and losses have been almost halved. Also cows are in better condition and conceive earlier. Numbered tags on the cows allow them to be culled more easily on performance, so that the best ones can be mated to top bulls by means of artificial insemination.

The only disadvantage of this system from a pasture management angle, is that with the cows off much of the hills during the period of shortest grass growth, weed reversion is being noticed. To overcome this, steers are being retained for an extra year and largely set-stocked on this country.

RESULTS

The streamlining processes discussed in this paper have saved some ten weeks of time in a full year. This is made up as follows:

	Weeks
(1) At each shearing, allowing for the weather, 3 to 4 days =	1
(2) At lambing	4
(3) No dagging	4
(4) Less shepherding for cast ewes	1
Total	10

Some of this time saved has been taken up in working with the ram breeding flock and the cattle. Nevertheless, it has made it possible to get through the crucial spring period in spite of the large increases in stock carried. It has also given more time to devote to development and maintenance work, and generally eased the management problem.

These alterations have been made on a farm where relatively large numbers of stock are carried on difficult country. They have also been made during times of stress for farmers when a hard look at some of the labour input was necessary. A farmer's advancing years has been a further factor contributing to the management changes.

ACKNOWLEDGEMENTS

I would like to thank N. Watson, Massey University and R. A. Firth, Manawatu Farm Management Consultants Inc., for their help in preparing this paper.

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MAKING PROVISION TO MAINTAIN CAPITAL STOCK IN A DROUGHT YEAR

J. C. ANDREW*

THE property, known as "Ica", of 2,900 acres, lies on the westerly side of the coastal range, 10 miles south west of Castlepoint and 27 miles from Masterton. Altitude ranges from 100 ft at the homestead to 1,200 ft; average rainfall is 38 in. (25 in. last year). The farm is well watered by the Whareama River on the western boundary and a permanent creek through the centre of the property. There are 250 acres of heavy clay river flats, 450 acres of lower mudstone hills running back into 600 acres of sandstone, and 1,600 acres of argellite.

Of the 2,900 acres, 1,900 are grazable; the remainder is under heavy manuka. We winter 3,800 breeding ewes, 1,600 hoggets—rams and killers, 220 breeding cows (all ages), 110 weaner heifers, and 20 rising 2-year steers and 6 bulls. The present ratio of cattle to sheep of 1 to 14 is the Wairarapa Farm Improvement Club average for this type of country.

The 1972 winter was cold and dry and followed by a normal, dry Wairarapa spring. Usually during November-December good rains provide ample summer feed, but this year they did not eventuate, and their absence, together with abnormal westerlies that blew incessantly from September until February, meant that by March the country was completely brown, bare, with nearly all cattle feed exhausted.

Good rains of 4 in. fell in March but this was followed by a further dry month with heavy westerly wind. Nine hundred cull ewes intended for slaughter in mid-January had to be held until late March, and 26 empty cows intended for slaughter in mid-April had to be carried until May 28. This made it almost impossible to save any quantity of autumn feed generated by the March rains for weaning calves.

In late October, 22 acres were sown in rape and turnips. These gave reasonable feed to fatten lambs in February, but the 28 acres of choumollier and swedes sown at New Year failed completely.

On the property there are 8 miles of mains-operated electric fence, which is proving one of the keys in the present reorganized management programme.

*"Ica", P.B., Masterton.

CATTLE MANAGEMENT

Calves are weaned in April, and the bulk of the weaner steers are sold; heifer calves are carried through until spring, when all except the 25 required for herd replacement are sold. Last spring we altered this policy, selling only the tail-end and mating the remainder with a view to selling the surplus in-calf in February-March.

After weaning, the cows are spread around the farm to clean up pasture until late June or mid-July, when they are boxed together and put into the scrub block of 1,200 acres, 200 acres of which is grazable. This block has usually been shut up for them from mid-January. It is always in excellent order and carries 200 cows comfortably for 2 to 2½ months. Most cows calve there on good feed with plenty of water and in excellent shelter.

In mid-September they are moved on to blocks closed up from mid-July, at a rate of one cow per acre. No sheep are run on these blocks.

A further 200 acres is then closed up and the cows move into this in mid-November when the bulls join them. The cows return to the first blocks after New Year from where they are weaned in April. These paddocks have good permanent water; I always try to keep cattle away from paddocks relying solely on dams for water during summer.

Over the past 10 years the yearling heifers have been mated, with a heifer loss over that period of only four. All rising 3-year-old heifers were in-calf again this autumn.

The rising 2-year heifers remain on the lower country for the winter. They may or may not get hay, depending on the feed situation. A month before calving, their feed supply is reduced. After calving, they are moved to spring-saved pasture, after which their management pattern follows much the same as that for the cows. As rising 3-year-olds they are given special treatment after weaning until they join the main herd in the scrub in June-July.

Provision is made for 1,200 bales of hay and 100 to 200 tons of silage. This is made according to the amount used the previous year. It is fed out in autumn while conditions are still dry. Self-feeding of silage in the winter has problems, unless one has proper concrete aprons, etc.

1972-73 SEASON

Basically, this was an abnormal season from the outset.

When the cows moved into their winter-spring-saved blocks in mid-September, the country was fresh but not carrying the usual

bulk of feed. The blocks shut up for late-spring feed produced only about half that expected. After the cows had finished this, the original blocks to which they customarily returned were nearly as bare as when they had left them two months earlier.

To complicate matters, the paddock shut up in late October, and expected to produce 1,200 bales of hay, dried and shrivelled up in the face of the unabated nor'westerlies. It was impossible to buy hay, but fortunately we managed in late-November to purchase 40 acres of pea stubble, at 20c a bale in the paddock as and when harvested, baling and transport charges additional—a gross charge of 45c per bale.

There was little option but to return the cows to the scrub block in January-February-March; thus to keep both cows and calves in reasonable condition meant the end of our basic winter reserve.

Weaning took place on April 12. Very little roughage was left on the rest of the property as the old ewes had seen to this—we were still carrying the 900 cull ewes destined for slaughter in mid-January.

It was clear in early March (and painfully clear now) that a complete rethinking of our normal cattle winter policy was necessary, or else capital stock would have to be sold.

With the assistance of D. Todd, Farm Improvement Club Adviser, the following plan was prepared:

After completion of all normal routine cattle work, *i.e.,* weaning, culling, pregnancy testing, Tb testing, dipping and drenching, it was decided to—

(1) Keep all in-calf rising 2-year heifers.

(2) Sell all empty heifers, cows, Tb reactors and cows in poor condition regardless of age.

(3) Topdress with nitrogen some 200 acres, 60 acres on the flats and 140 acres on the hills (nitrogen was applied in April).

(4) Use what feed was available on the hills for rising 3-year-old heifers.

(5) Carry the rising 2-year heifers as long as possible with the lambs on the flats.

(6) Put all cows on to a pea straw supplement with the stated intention of reducing their body weight by 150 lb during the following 7 or 8 weeks, feeding at a rate of 15 bales per 100 cows.

(7) Close up 27 acres on the hills as a reserve for the rising 2-year heifers (*i.e.*, ½ acre per beast).

(8) Break feed all hill blocks topdressed with nitrogen by use of a temporary two-wire electric fence, operated from the main farm electric service system.

(9) Hold in reserve 60 tons of silage to use either after the pea straw was exhausted or for 2-year heifers prior to calving in late July or August.

Costs shown in Table 1 indicate that the expense per cattle beast wintered would be approximately $5 per head.

TABLE 1: DIRECT DROUGHT COSTS

Purchase, baling and transport of 1,200 bales pea straw @ 45c a bale		$ 540
10 tons of Diamophos	$850	
Cartage	$ 95	
Aerial spreading charges	$156	
		$1,101
Additional electric fence equipment		$ 67
		$1,708

To date (June) the weather has been mild but pasture growth has been slow because it is still dry. The operation as planned is working, but feed is still very short.

The projected weight drop in the cows on pea straw was achieved, and they have now gone on to break-fed, nitrogen-boosted hill pasture. We are satisfied with them; they are looking better for the change to grass.

The 3-year heifers have finished their country and for the next month will move ahead of the hoggets and then join the main herd of cows. Their condition is satisfactory.

The rising 2-year heifers are good, mostly fat, and no worries are expected. Their weight will be dropped during the last month before calving, using the remainder of the pea straw and the silage.

The weaners and 2-year steers have sufficient feed but none to spare.

THE FUTURE

(1) More fodder crops are necessary to produce a feed reserve for either sheep or cattle.

(2) More silage needs to be stockpiled.

(3) Improved water supply would give better utilization of areas now restricted to summer-autumn grazing by sheep.

(4) Conversion of existing hay barns to self-feeding structures will greatly reduce labour requirements for cattle in autumn.

Cattle: To increase cattle numbers greatly would mean considerable capital outlay in water, hay barns and feedlots.

Polwarth sheep: Over the past five years experiments have been made with a fine-woolled sheep, a $\frac{3}{4}$-bred Merino known as the Polwarth, producing a 58/60 wool. Last year wool from these sheep returned a premium of 50c/kg, and this year 100c/kg over the wool from the Romney flock. To be specific, 10% of the flock produced 25% of the total wool income this year. At no stage since 1969 has this wool been sold at less than 100c/kg.

In this dry, nor'westerly-beaten area of the Wairarapa East Coast, to increase beyond the average sheep and cattle ratio could well be hazardous, as opposed to looking very carefully at what can be done with sheep.

CONCLUSION

(1) All capital breeding stock will have been retained despite one of the severest droughts in 30 years.

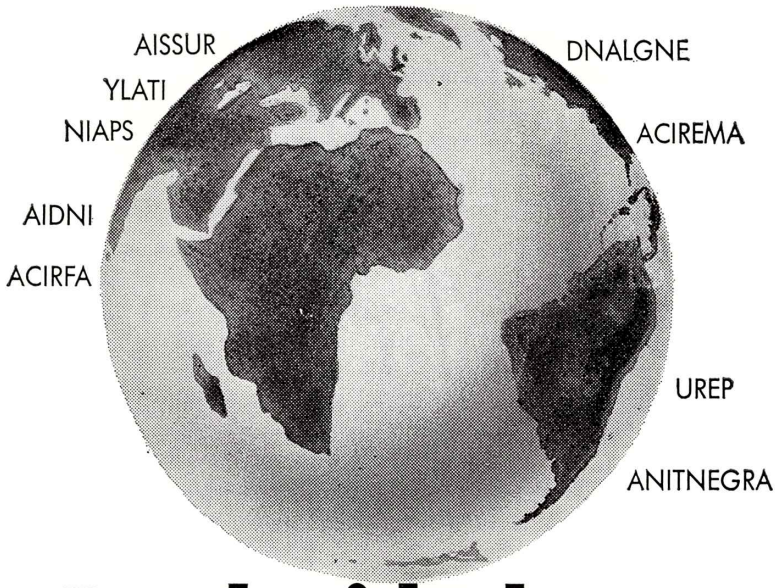
(2) All aged and poor cows have been sold, the dry cows have been slaughtered and those in-calf have been sold as breeders at above the meat schedule price.

(3) The average age of the herd has been reduced so that breeding and performance records of each cow can now be kept.

(4) No outside grazing on drought relief assistance has been necessary.

I believe every farmer has a responsibility to plan a reserve of feed that will enable him to manage his stock through all but the most serious drought. Not every drought can be met through planning, but most can be, from within the farmer's own resources.

The National Drought Relief Scheme requires re-examination. Farmers must approach it on a self-help basis, not as a national rescue exercise. The present system is more political than practical. In its place incentives should be directed towards the greater use of reserve fodder crops, stockpiling of silage, storage of hay, straws, etc., in simply-built self-feeding structures, improved water supplies and the use of nitrogen as a fertilizer.



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MODERN FARMING TRENDS AND SOME PROBLEMS OF WET SOIL

D. G. BOWLER*

SOIL AND WATER are the basic raw materials of the agricultural industries. The prime function of the soil is to provide a favourable living space for plants, supplying nutrients, air, water, warmth and anchorage; the extent to which these are provided will be reflected in certain levels of plant production. However, the soil, when used for farming, must also provide living space for farm animals and access for various wheeled machines and as land use becomes more intensive the primary function of the soil becomes affected by its secondary role as a traffic surface.

At some stage in intensive land use there comes a challenge to soil management skills and the extent to which these are developed and applied will be reflected in various degrees of profitable farm production.

Soils can be raised to very high levels of fertility to meet the needs of intensive farming if the fundamentals are clearly understood.

SOIL STRUCTURE AND ROOT DEVELOPMENT

Most plant nutrients are supplied from the top 30 cm of the soil but water must be sought by many high-producing plants from greater depths; hence, ease of root penetration through the soil profile becomes an important factor in plant productivity. It is essential, therefore, that a continuous system of pores and fissures wide enough for roots to enter should be available—that is, the structure of the soil should provide this opportunity for penetration.

The structure of the soil refers to the manner in which the primary soil particles are aggregated within it. A natural aggregate is called a ped and although structural units may be extremely irregular there are four main types recognized according to their general form—plate-like, prism-like, block-like and spheroidal. These are again divided into a range of subtypes.

Structure influences many important properties of the soil such as the rate of intake or infiltration of water, and permeability,

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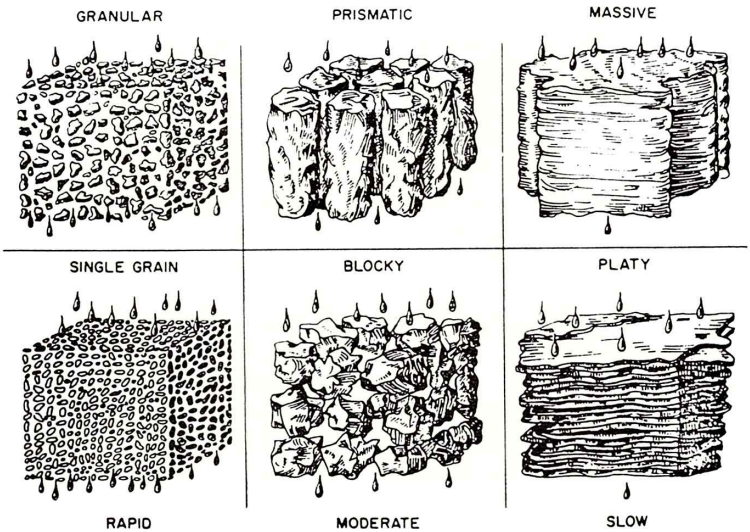

FIG. 1: *Soil structure influences water movement as shown. (Source:* USDA Agric. Inf. Bull. No. 199.)

that is, the ability of the soil to transmit air and water. Figure 1 portrays graphically the relationship between type of structure and these two hydrologic properties.

Both granular (spheroidal) and single grain (structureless) soils have rapid infiltration and permeability; blocky (block-like) and prismatic soils have moderate rates; platy and massive structures result in slow rates.

Plant roots that are larger than 0.2 mm can be readily observed and while in theory all soil pores greater than 0.075 mm diameter are gravity drained, roots need pores and fissures from two to five times greater than this for penetration. The density and extent of the visible root system of established plants is thus an indication of the spacing, arrangement and length of an effective section of the drainable pores in soils.

The more successfully the soil is managed to provide for vigorous root systems, the more highly productive the plants will be because they can thus explore significant volumes of soil for their nutrient supplies and water.

THE DEVELOPMENT OF AGGREGATION

While the formation of structure involves processes that are complex and there are some uncertainties about the exact

mechanism by which granules form, several specific factors are known to influence their genesis. These are:

(1) Wetting and drying.

(2) Freezing and thawings.

(3) The physical activity of roots and soil animals.

(4) The influence of decaying organic matter and of the slimes from the micro-organisms and other forms of life.

(5) The modifying influence of adsorbed cations.

(6) Cultivation and mechanical treatments.

Any action that will develop lines of weakness shift the particles about, and force contacts which might not otherwise occur will influence aggregation. Consequently it can be expected that the activity and movement resulting from the above-listed factors encourage aggregate formation. The planned use of the mole plough, and, in more restricted conditions, the sub-soiler, provide a cheap, efficient means of fracturing the profile and improving structure.

The major influence in structure development, however, is organic matter which not only binds but also lightens and expands, making possible the porosity so characteristic of individual soil aggregates. Three kinds of organic matter usually occur in soils and each has different biological, physical and chemical effects on soils. They are the visible root systems of plants, partly decomposed remains of plants, and well-decomposed black or brown organic matter commonly called humus.

The incorporation of crop residues in the soil contributes large amounts of organic matter but the development of high fertility pastures is the most effective and convenient means of improving soil structure, provided either natural or artificial drainage is assured.

DRAINAGE

Since good soil structure can be shown as essential for satisfactory plant production it is also true that it is difficult if not impossible to have good structure without efficient drainage, either natural or artificial. Soils capable of sustaining productive plants must provide both air space and adequate moisture. However, there are important differences between soils in the amounts they contain as Table 1 shows.

TABLE 1: APPROXIMATE TABLE OF AIR CONTENT AT FIELD CAPACITY AND AVAILABLE WATER CAPACITY TO DEPTH OF 75 cm.
(Modification of Gradwell and Jackson (1970))

Location	*Soil Group*	*Soil Type*	*Air Content at Field Capacity (mm)*	*Available Water Capacity (mm)*
Taupo	Yellow-brown pumice soils	Taupo sandy silt	238	187
Rangitikei	Central yellow-brown earths	Mangaweka silt loam	106	119
Manawatu	Yellow-grey earths	Tokomaru silt loam	63	109

It is a feature of poorly-drained soils that, within a nominal root zone of 75 cm, air space is comparatively low in volume. It follows, therefore, that rain storms of comparatively low intensity will cause saturation and in such an event only small amounts of rainfall will be needed to maintain the waterlogged condition, especially in winter and spring when temperatures are low.

Making an analysis of records in a district and relating dominant rainfall events to the air space of soils in the area will provide a measure of the risks involved in such matters as planning a cropping programme or in building up herd numbers, especially where the waterlogging of soils is likely to be a limitation. If the hazards are thus established, advanced precautions can be taken, such as deciding on standards of drainage or formulating alternative management plans. An example of this procedure is given in Table 2.

TABLE 2: MEAN AIR CONTENT OF SOIL PROFILES AT FIELD CAPACITY AND RAINFALL FREQUENCIES FOR TWO MAIN SOIL GROUPS
(Based on Robertson (1963))

Location	*Soil Group*	*Mean Air Content at Field Capacity to 75 cm Depth (mm)*	*Approx. Return Period of Rainfalls that Exceed Detention Capacity (years)*			
			2 h	*6 h*	*24 h*	*48 h*
Taupo	Yellow-brown pumice soils	265	50 yr	50 yr	50 yr	20 yr
Manawatu	Yellow-grey earths	75	50 yr	20 yr	2 yr	1 yr

The two soil groups in Table 2 show sharply contrasting air contents, the pumice soils having nearly four times that of the yellow-grey earths. Rainfall events rarely occur in the Taupo area capable of causing waterlogging, while in the Manawatu annual rainfall in a 48-hour period causes saturation while the chances are that the problem will also occur in a 24-hour period in alternate years.

Once a soil becomes wet its ability to support the weight of animals and machines sharply declines and continued use of the land is likely to result in damage to soil structure by compaction in the surface layers. Infiltration capacity will be affected and ultimately plant vigour will decline.

The benefits of drainage are not in doubt: it results in an increase in the depth and improved aeration of the root zone, the soil warms up more quickly, germination is better, and spring cultivations can be carried out earlier, thus reducing the risk of soil damage by untimely cultivation; deep rooting is encouraged, resulting in stronger plants better able to withstand drought. Farm drainage standards should vary according to the form of land use intended; systems required for pastureland and sheep flocks are unlikely to provide fully satisfactory soil conditions for a

TABLE 3: DRAINAGE COEFFICIENTS FOR DIFFERENT LAND USE SYSTEMS

Land Use		*Drainage Coefficient (mm)*	*Equivalent Water Volume per Hectare (m^3)*
Livestock	*Field*		
*Intensive beef cattle	Special wet weather pastures	25	250
*Intensive beef cattle	Good pasture for grazing	12	120
Predominantly sheep and some cattle	Average pastures, frequent cropping	12	120
Predominantly sheep and some cattle	Average pastures, occasional cropping	6-8	60-80
Predominantly sheep, medium stocking rate	Average pastures	4-6	40-60

*Use of cattle pads or a naturally free-draining area is recommended in prolonged wet periods.

significant increase in cattle numbers or an increased rotation of grass and crops; far less for repetitive cropping.

New demands being placed on the land now and in the future require drainage systems so designed that they can be intensified to meet a changing farm management situation. Specifically such standards are determined by what is known as the "drainage coefficient" a term which means the volume of water which must be removed from a field in 24 hours to provide for a certain type of land use. Different systems of farming and economic considerations strongly influence the selection of suitable coefficients but the figures in Table 3 are a guide to reasonable standards on poorly-drained soils.

The manner of achieving selected standards of drainage, however, covers the gamut of farm drainage design and cannot be dealt with in this paper.

SOME PROBLEMS AND SOLUTIONS

GRASSLANDS

Soils with clay pans are naturally poorly drained and, even when artificially drained, flexibility in land use will depend upon reasonable maintenance of mole and pipe systems. When the farm has been extensively underdrained it is recommended that an annual rotation of inspection be adopted in which not less than 20% of the drained area should be inspected at the wettest time of the year; where weaknesses are observed, these should be remedied in the next most favourable period for whatever action is needed. Such a procedure ensures that the entire drained area is closely inspected and serviced every five years; consequently deterioration cannot develop on a scale which would be difficult and expensive to correct.

The advantage of a maintenance routine is one of flexibility in land use. Areas required for cropping can be selected from fields inspected in the previous years with the confidence that soil moisture conditions will be as favourable as possible for any operation from ploughing through to harvesting.

On clay soils, mole drainage may remain serviceable for as long as 20 years but at some stage renewal becomes necessary. When carried out under favourable conditions, moling is a soil treatment which initiates the development of improved structure. The quality of the moles is strongly influenced by the weather immediately after the operation; if it is wet the response is usually

not so good as when it is dry. The operation should be timed for when the soil is drying out, starting from about field capacity, and continuing through to about a 30 mm rainfall deficit. The grass should be short, leaf length not more than about 25 mm, and soil temperatures 10°C or more. In these circumstances drying can occur deep into the profile cracks created by the mole plough blade and structure formation is initiated very rapidly.

The soils on grasslands are best protected from pugging by dense pastures with a minimum leaf length of 50 mm. Where possible, heavy cattle should be held on cattle pads, or, if available, on naturally dry areas during prolonged wet weather and at least spread thinly over the fields if these special arrangements are not possible.

Pasture damage by pugging can cause important changes in the botanical composition of swards and ultimately a reduction in yield (Edmonds, 1966).

CROPPING AND CULTIVATION

Repetitive cropping on clay soils has a limit. Efficient drainage systems are quite essential if damage to structure is to be avoided by the movement of cultivation machinery. Wet or very damp soils should be given time to drain out before work commences. If structure is damaged and infiltration impeded, surface pounding will very likely occur in wet weather. Untimely cultivation in the spring owing to an increase in contract growing, for example, often means that operations are carried out when soils are partly waterlogged. The consequent effects of compaction and soil smearing can be very damaging, causing impeded drainage even on well-drained soils. It is advisable, therefore, to choose reasonably dry conditions for cultivation since soil damage may reduce the effectiveness of even the most efficient subsurface drainage system. Returning a field to grass is the best way to restore a favourable structure.

Many forage crops have deep-rooting systems which may rapidly proliferate in the backfill of pipelines and cause blockages. Choumoellier and maize are likely to be closely associated with beef cattle herds and offer this risk, while lucerne may also cause some difficulties. The problem is easily avoided, however, by leaving one drill width over the pipeline in grass or by planting a shallow-rooting crop like swedes along the line.

The seedbed of a field intended for pasture should be left as smooth as possible, particularly where mole drainage is involved.

The performance of moling systems is maximized and the overall costs of subsurface drainage are reduced substantially by smooth grassed surfaces.

LIVESTOCK NUMBERS AND KINDS

Heavy soils adequately drained for sheep farming are unlikely to provide suitable conditions for a significant change to cattle; some intensification of the existing drainage system is frequently necessary. Surface compaction by the hoofs of cattle will soon cause pasture damage and surface ponding in heavy rainfall, owing to an alteration of infiltration rates. Maintaining a dense pasture cover is the best way to protect the soil and ensure drainage in wet weather but this requires suitable herd management. The use of naturally free-draining areas, if available, or specially constructed cattle pads is strongly recommended (Bowler, 1971).

Where cattle are being intensively grazed on flats surrounded by steep hills, stormwater run-off is likely to cause waterlogging, even on reasonably well-drained soils. The solution to this problem will usually be found in constructing a diversion terrace near the foot of the slope. Gradients along the terrace should approximate 1% and, while the cross-section should be adequate for the catchment, this should never be less than one square metre. Desirably a diversion terrace should be especially designed for the site and it is essential that cattle be excluded with a fence to avoid damage to the channel.

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LUPINS—OLD CROP WITH A NEW POTENTIAL

N. J. WITHERS*

LUPINS have been grown on sheep farms in New Zealand since the early 1900s. Their main use was on the light land in Canterbury, initially as green manure and later as a forage crop. Their chief advantages in this situation were soil fertility build-up, and superior drought and disease resistance to brassicas (White, 1961). The early varieties contained high levels of an alkaloid which made the plant unpalatable and sometimes toxic. The development of low alkaloid "sweet " varieties increased interest in the crop as a forage, and lupin was often used with rape as a lamb-fattening crop. Popularity reached a peak in 1945 when an area of 6,500 acres was planted for seed production alone (White, 1961). Since the 1950s interest in lupins has declined markedly.

A combination of factors has recently revived interest in lupins, not as a forage crop, but as a seed crop. Demand for a protein to supplement cereal grain in meals has arisen with the increased size of the pig and poultry industries and the reduced availability of milk proteins for the pig industry. The normal protein supplements, namely, meat and fish meals, have recently increased sharply in price, creating interest in alternative supplies including vegetable proteins. The protein in lupin seed is of good quality, very similar to soya bean meal extensively used in the United States.

Information on lupins as a seed crop is limited. Recommended sowing rates vary from ¾ to 3 bushels an acre, both spring and autumn sowings are suggested, and reported yields fluctuate between 10 and 57 bu/ac (Hudson, 1934; Hamblyn, 1940; van Steveninck, 1956). All report high losses at harvest owing to shattering of pods when mature.

VARIETIES

Varieties developed in Europe and Western Australia have little or no shattering so they have overcome this limitation of lupin as a seed crop.

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Three varieties developed by Gladstones in Western Australia with similar names and similar characteristics have performed well in trials in New Zealand. These varieties are:

Uniwhite: Similar in characteristics to the bitter, blue lupin except that it is "sweet", with white flowers and seeds and with a reduced rate of pod shattering. It is the main variety available.

Uniharvest: Identical with Uniwhite except that it is completely non-shattering.

Unicrop: Also non-shattering, but has had its vernalization requirement removed which makes it earlier maturing under certain conditions.

Spring-sown trials last year produced yields varying from equivalent to 63 to 71 bu an acre for these three varieties.

Another variety called Weiko III is also available. This is a different species from the others and has broader leaves and yellow flowers. It is better adapted to wet conditions and the seed has a higher protein content. However, trials overseas (Gladstones, 1972) have shown that yields are lower. At Massey University last year, an autumn-sown trial yielded 58 bu an acre from Uniwhite but only 31 bu an acre from Weiko III.

Borre, a variety released in 1956, would also be suitable, but it is difficult to distinguish from the bitter blue variety and suffers from high shattering losses at times.

PLANT DEVELOPMENT

In order to understand fully some of the requirements and problems with this crop, knowledge of the development of the plant is desirable. Until flowering commences, the lupin is predominantly a single stem with a number of short side stems mainly arising near the base. At this stage, the stand is relatively open, particularly with spring-sown crops which tend to be shorter with fewer and smaller side stems.

Flowering commences with the appearance of a flower bud at the top of the main stem which produces a large number of flowers, most of which do not set pods. At the same time secondary stems are stimulated and make rapid growth, producing a sequence of usually up to four sets of flowers each, the actual number depending on how long suitable environmental conditions last. Early-sown crops tend to produce bigger plants and a greater number of flowers. This means that flowering will continue over a number of weeks if conditions are suitable, stopping usually

when moisture becomes limiting. Sowing dates should be adjusted to allow adequate soil moisture, at least during early flowering.

Spring sowing is satisfactory in the Manawatu district. It is probably preferable to autumn sowing here because lupins do not tolerate the wet conditions occurring in many New Zealand soils over winter. An exception may be the coastal sand country where late autumn sowing may be suitable to enable flowering to occur before the soil becomes too dry in spring.

FIELD TRIALS

The influence of time of spring sowing was the subject of a trial at Massey University in 1972. As shown in Table 1, yields generally decreased as sowing became later. The fifth sowing was the exception to the trend and this increased yield was attributed to 22 mm of rain which fell during flowering. This response to a small amount of rain illustrates the sensitivity of lupins to moisture stress at flowering. The spring of 1972 was drier than normal and the drop in yield is probably greater than would be expected in a normal season in this area but probably closer to normal on dry soils, or in drier areas such as the Wairarapa. However, because of the sensitivity to moisture stress during flowering, sowings as early as possible in the spring are probably preferred.

For these reasons the earlier flowering variety Unicrop may be the best variety for late spring sowing. Table 1 also shows the flowering dates of Unicrop and Uniharvest which has flowering characteristics similar to Uniwhite. As sowing dates became later, Unicrop flowered increasingly early relative to Uniharvest. Thus the use of Unicrop in late sowings would increase the chances of flowering occurring during good conditions and result in an earlier

TABLE 1: YIELDS AND FLOWERING DATES FOR SEQUENTIALLY SOWN UNIHARVEST AND UNICROP 1972
(After Withers (1973))

Sowing Date 1972	*Yield* (g/plant)*	*Date of Flowering*	
		Unicrop 1972	*Uniharvest 1972-3*
Aug. 3	38	Nov. 1	Nov. 3
Aug. 19	34	Nov. 6	Nov. 12
Sep. 7	28	Nov. 17	Nov. 24
Sep. 22	22	Nov. 24	Dec. 11
Oct. 5	32	Dec. 5	Dec. 21
Oct. 20	18	Dec. 18	Jan. 11

*Uniharvest only. There was no significant difference between varieties.

harvest. For example, the sixth sowing in the above-mentioned trial was harvested on February 20, 1973 for Unicrop and on March 26, 1973 for Uniharvest. There was little difference between varieties with earlier sown crops.

The situation with sowing rate is not clear. Lupins seem to be flexible, as widely spaced plants produce a sequence of flowerheads and pods and tend to expand to fill gaps in the stand. Sowing rates of 90 to 135 lb/ac (100 to 150 kg/ha) seem to produce good yields and so far only small yield increases have been obtained at Massey to increased rates, but some Canterbury farmers report good responses to higher rates. Work in this field is planned for the next year. It is possible that earlier sowing will require lower rates than later sowing, owing to the increased plant size, and number of flowers, of early-sown plants.

WEEDS AND PESTS

Weed control is critical, especially in spring-sown stands. Lupin stands tend to be very open until flowering approaches, allowing weed establishment which can ruin a crop. Lupins are very sensitive to "hormone" weedkillers and no satisfactory post-emergent herbicide is yet available. However, the pre-plant herbicide trifluralin is known to be effective but there are a number of weeds that tend to be resistant to this chemical. Trials at Massey have shown that simazine and atrazine applied after sowing and before the crop emerged are very effective at rates between 1 and 2 lb/ac active ingredient (1.12 to 2.24 kg/ha). Other chemicals have been tested but none has yet been found to be as effective against a broad range of weeds.

Diseases are likely to be a major problem with this crop. Lupins are susceptible to a wide range of fungous diseases including the common damping-off, sclerotinia and botrytis diseases. There is little that can be done about this except to treat the seed at sowing and take care in the rotation. Lupins should not follow other legume crops which have shown signs of fungous disease. Avoiding wet soils and sowing when conditions are suitable for rapid establishment will also help minimize the problem. A cereal-lupin rotation is probably the safest from a disease point of view as well as being a useful combination for fertility maintenance. Bean yellow dwarf virus can be a problem also and as it is transmitted by aphids, control of aphids is important. The most critical period for aphid attack seems to be when the first flowerhead is just emerging. At this time aphid numbers can build up very

quickly. They can do direct damage to this flowerhead as well as transmit virus.

Other common pests can be slugs at early establishment under damp conditions, and rabbits or hares can also be very destructive. The plants may sometimes recover from attacks but often the maturity times of these plants are delayed, giving problems at harvest.

HARVESTING

Now that shattering at harvest has largely been overcome with the new varieties, harvesting is not the problem it once was. Direct heading is possible and windrowing should be used only if weeds are a problem. Although few pods shatter, pods can be lost owing to wind movement knocking them off the plant. This is seldom a problem unless there is uneven maturity of pods so that the first to ripen have become very brittle while waiting for the last pods to dry. Uneven maturity can occur with early-sown, high yielding crops. This problem seems to be worse with Uniwhite, as Unicrop and Uniharvest apparently have more even ripening characteristics. If drying facilities are available, harvesting when the first pods start to fall and artificially drying the green seeds is possible as lupins thresh quite easily in the semi-green condition. Chemical desiccation prior to harvest does not seem to be very successful.

Although not settled yet, the price of lupins seems to be about $2 a bushel in the Manawatu. At that price a yield of about 40 bu an acre should make lupins competitive with average yielding cereal crops. Experience by the writer involving his trial results and one commercial crop in this area last year would suggest that 40 bu an acre can easily be achieved in the Manawatu and the better land in Canterbury is also reaching this yield.

If lupins again find a place in farming it should be possible to achieve better yields with varieties selected for the New Zealand environment. Lupin is relatively primitive as a crop plant and there are at least four species, with many diverse types within these, so there is plenty of scope for selection.

The crop is spring-sown and short maturing so will fit well into most cropping programmes or between winter forage crops and, being a legume, it will find a useful place as a fertility builder in the rotation.

There is sufficient knowledge to produce satisfactory yields in the Manawatu and with experience and more trial work yields can be further improved.

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A COMPARISON BETWEEN ANGUS, GALLOWAY, AYRSHIRE AND FRIESIAN STEERS FOR GROWTH AND CARCASS CHARACTERISTICS—TRIAL VII

R. A. BARTON*

STUDIES were commenced at Massey University in 1963 to characterize some of the important features of steers of different beef and dairy breeds and crosses. In these trials the animals have been grazed together on pasture and fed hay or straw in some seasons, or have been confined in a pen where they were fed roughages and/or barley meal for a period in the winter. The details of the management of the steers and the results obtained have been reported in previous issues of *Sheepfarming Annual* (Barton, 1966—Trials I to III; Barton, 1968—Trial IV; Barton, 1971—Trial V; Barton, 1972—Trial VI).

Collectively in these previous trials some four beef breeds (Angus, Hereford, Beef Shorthorn and Galloway), two dairy breeds (Milking Shorthorn and Friesian) and two crosses (Charolais-Jersey and Friesian-Jersey) have been compared. The present paper reports the performance and carcass characteristics of Angus, Galloway, Ayrshire and Friesian steers when slaughtered at approximately 30 months of age.

MANAGEMENT OF THE ANIMALS AND EXPERIMENTAL PROCEDURE

Fifteen steers of each breed were purchased in April, 1971, when the animals were about eight months old. The Angus and Galloway calves had been single-suckled on their mothers. The Angus animals came from the same Poverty Bay herd as those in Trial VI while the Galloways were bought in the Horowhenua district. The Ayrshire calves had been reared using various methods ranging from suckling nurse cows as pairs for 5 to 6 months to bucket rearing either on whole milk till 9 to 10 weeks of age or on whole milk for their first three weeks of life and then gradually changed to a diet of one part whole milk to one part of water or to a 60:40 milk to water diet for six weeks following three weeks on whole milk. Nine of the Ayrshire calves were

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raised on nurse cows in the Taranaki province and subsequently were sold to a farmer in the region, while the remaining six calves were raised in the southern Manawatu district on two properties separated by several miles. The Friesians were bucket reared in the Bunnythorpe district and after weaning were sold to a farmer in the Marton area.

The Angus weaners were selected by the vendor who was also their breeder; the Galloways were selected by a member of the Galloway Cattle Society; the Ayrshires were selected by representatives of the Ayrshire Cattle Breeders' Association; and the Friesians were selected by a member of the Massey University sheep farm staff. The purchase price of each breed was proposed by the various vendors and agreed upon by the University. The calves were bought at a per-head price. This sum, plus their cartage cost, was divided by their liveweight at the start of the trial on May 10, 1971, to give the average price per pound for each breed. This figure, as cents per pound liveweight, is presented in Table 2. The price varied according to breed, to locality and to date of purchase so comparisons cannot strictly be made between breeds for this item, nor can they be used to calculate "profit" on a breed basis.

As weaners in their first winter, the cattle were confined in a pen from June 14 to August 23, 1971, and were fed 12 to 13 lb meadow hay and 1.5 lb crushed barley a head daily.

In their second winter, the cattle were again confined in a pen from July 6 to September 1, 1972. They were fed 13.7 lb of meadow hay and 30 lb maize silage a head daily during this period.

Apart from the two periods in the winter when they were pen fed, the cattle grazed pasture only without hay or grain supplements on the University's No. 1 Sheep Farm or on the "Ripley Rise" leasehold property. Their growth rates were adversely affected in the unusually dry summers of 1971-2 and 1972-3, during which time they grazed pasture only.

The cattle were drenched routinely to control internal parasites and sprayed for lice control as thought necessary.

The cattle were weighed on the dates given in Table 1. The number of Angus steers at the end of the trial was 13 owing to a death from bloat and an accident suffered by another beast. One Friesian was removed from the trial because it developed an allergy, presumably through eating a noxious plant growing on waste land. One Galloway carcass was condemned because of

tuberculosis. All the Ayrshire steers completed the full period of the trial without incident.

The cattle were slaughtered and their carcasses measured and boned out at an export slaughterhouse and meat packing plant, respectively. There were five slaughter dates, each followed a day or two days later by five measuring and boning-out dates. This procedure differed from that used in previous trials as it was necessary to kill small lots of cattle at each date so that meat tenderness assessments could be made concurrently in the laboratory without overtaxing the facilities. Because of these requirements, the growth rate data terminated 24 hours before the first lot of cattle were killed, but they covered a period of 665 days, while the dressing-out data were based on the carcass weight as a percentage of liveweight obtained some 24 hours before the slaughter of each of the remaining four lots of steers.

The steers within each breed were allotted at random to the slaughter lots. The slaughter dates of the lots were (number of steers in each lot in parentheses): March 6, 1973 (12); March 7 (12); March 12 (12); March 13 (10); March 19 (10).

At slaughter, and on the day or the second day after slaughter, the information presented in Table 2 was collected following the procedures used in previous trials.

RESULTS

Liveweight Growth

The mean liveweight changes of the four breeds of cattle at the various weighing dates are given in Table 1.

These results indicate the variability between breed groups for liveweight growth over the period of the trial. They also show that in the winter months growth rate slows down, and indeed during one short period in the late winter-early spring there was a slight reduction in group means between August 23 and September 14, 1971, except in the case of the Ayrshire steers, which were able to maintain their weight at that time. On the other hand, during the 31 days in the spring from September 14 to October 15, 1971, the Angus, Galloway, Ayrshire and Friesian steers gained 102 lb, 103 lb, 104 lb and 134 lb, respectively. These figures, expressed as daily liveweight gains for each breed, were: 3.29 lb (Angus); 3.32 lb (Galloway); 3.35 lb (Ayrshire) and 4.32 lb (Friesian).

It will be noted, too, that at the end of the trial the cattle were losing weight as the result of severe drought conditions and the absence of supplementary feed.

TABLE 1: MEAN LIVEWEIGHT OVER 665-DAY PERIOD OF STEERS OF FOUR BREEDS IN TRIAL VII

Weighing Date	*Angus (lb)*	*Galloway (lb)*	*Ayrshire (lb)*	*Friesian (lb)*
1971				
May 10	543	365	405	438
Jun. 14	531	362	413	449
Jun. 28	540	373	434	467
Jul. 12	544	386	447	481
Jul. 26	559	388	463	501
Aug. 9	567	391	471	508
Aug. 23	590	406	489	530
Sep. 14	589	397	489	529
Oct. 15	691	500	593	663
Nov. 16	749	569	659	731
Dec. 14	808	619	714	797
1972				
Jan. 26	871	692	776	876
Feb. 21	904	731	814	916
Mar. 28	849	682	797	894
May 2	868	704	827	922
Jul. 6	862	686	826	901
Jul. 27	916	722	880	971
Aug. 18	925	738	883	983
Sep. 1	945	770	910	1,026
Oct. 17	968	764	921	1,041
Dec. 12	1,156	925	1,085	1,242
1973				
Feb. 9	1,199	1,005	1,137	1,296
Feb. 26	1,215	1,021	1,147	1,320
Mar. 5	1,201	1 023	1,135	1,305
No. of steers	13	14	15	14

The changes in weight gain for each breed when fed in a pen and during other seasons have not been analysed in this or in previous trials but will be the subject of a further report.

Production and Carcass Characteristics

It will be noted from an inspection of the figures in Table 2 that the Angus cattle had the highest average liveweight at the start of the trial on May 10, 1971, followed by the Friesians, which, on average, were 105 lb lighter. However, at the end of the trial the Friesians were 104 lb heavier than the Angus steers. They achieved this by gaining 0.31 lb a day more liveweight than the Angus steers over the 665 days of the trial. This represents a 31% faster weight gain for the Friesians compared with the Angus steers.

TABLE 2: MEAN LIVEWEIGHT AND CARCASS DETAILS OF STEERS OF FOUR BREEDS SLAUGHTERED AT 30 MONTHS IN TRIAL VII

	Angus	*Galloway*	*Ayrshire*	*Friesian*
No. of steers	13	14	15	14
Purchase price/lb liveweight (cents)	16.3	15.8	13.3	13.7
Liveweight (lb):				
At start (May 10, 1971)	543	365	405	438
At end (Mar. 5, 1973)	1,201	1,023	1,135	1,305
Gain over 665 days	658	658	730	867
Daily gain over 665 days	0.99	0.99	1.10	1.30
Carcass wt (lb)[1]	622	524	556	653
Carcass grades:				
GAQ	12	11	—	—
FAQ	—	1	2	1
YAQ	1	2	12	11
Boner	—	—	1	2
Dressing-out %[2]	51.4	51.9	49.1	50.2
Kidney and channel fat (lb)[3]	14.6	11.7	21.8	21.8
Trimmed, boneless meat %[4]	62.4	63.7	60.6	60.9
Excess fat %[4]	15.5	13.6	15.1	15.0
Bone %[4]	22.0	22.8	24.3	24.2
Fat depth at 12th rib (mm)	11.3	9.2	5.3	5.1
Ribeye area at 12th rib (sq. in.)	11.69	9.79	9.50	10.21
Fat colour[5]	1.0	1.0	1.1	1.3

Notes: [1]Carcass weight=hot carcass weight minus kidney and channel fat.
[2]Dressing-out %=carcass weight as a percentage of liveweight taken 24 hours before slaughter.
[3]Total kidney and channel fat, *i.e.*, both sides of the carcass.
[4]Right chilled side of each carcass with its kidney and channel fat weight added to make the percentage figures comparable with those of previous trials.
[5]Fat colour. The smaller the number the whiter the fat.

The Ayrshire steers gained more weight over the whole period than either the Angus or Galloway cattle, but their rate of growth was less than that of the Friesians. Although the Galloway steers were the lightest at both the start and end of the trial, their daily liveweight gain over the 665 days was identical to that of the Angus cattle.

The carcass weights of each of the four breeds followed the order of their final liveweights. Thus the heaviest average carcass weight was attained by the Friesian steers, followed by Angus, Ayrshire and Galloway steers, in that order.

The dressing-out percentages were higher for the two beef breeds and lower for the two dairy breeds, with the Ayrshire steers

having the lowest dressing-out percentage. A low dressing-out percentage discounts some of the advantage of a rapid growth rate and heavy final liveweight, but, because the Friesians in the present trial were well ahead of the other three breeds in growth rate and final liveweight, their relatively low dressing-out percentage did not mean they would have a carcass weight below that of the Angus steers with their high dressing-out percentage and a final liveweight which was second to that of the Friesians.

In carcass grading, the Angus carcasses were ahead of the other three breeds followed by the Galloway, Ayrshire and Friesian carcasses, in that order. The Ayrshire and Friesian carcasses were mainly placed in the YAQ and Boner grades because of insufficient fat cover on the loins and rounds and their general shallowness of flesh as assessed subjectively by the works' grader and the New Zealand Meat Producers Board district supervising grader.

Three carcasses were graded as Boner, one among those slaughtered in the first lot on March 7, 1973, and two among those slaughtered the following day. These three carcasses returned a schedule price that was $1/100 lb carcass weight below that for the YAQ grade into which they would have been placed if they were slaughtered in the later lots. (YAQ is for young Boner-type carcasses, and as all the 56 steers were of approximately the same age there was no obvious reason for regarding three of them as older than the others and, therefore, placing them in the Boner grade. See Barton (1972) for a description of the beef export carcass grades.)

The dairy-bred steers had more kidney and channel fat than the beef-bred steers. The Galloway steers had less of this fat than the Angus steers and the two dairy breeds had equal amounts.

The Galloway carcasses had the highest average percentage of trimmed, boneless meat, followed by the Angus, Friesian and Ayrshire steers, in that order.

In the immediately previous trial (Trial VI), the Galloway carcasses also had the highest average percentage of trimmed, boneless meat, but on that occasion they were only 0.5% higher than the Friesian carcasses. In the present trial, the average figure for this important carcass characteristic is 2.8% higher for the Galloways compared with the Friesians.

The Galloway carcasses had the lowest average percentage of excess trimmed-off fat and the second lowest average bone per-

centage. This explains why their percentage of trimmed, boneless meat is highest among the four breeds in the trial.

The depth of fat over the ribeye at the 12th rib is an important characteristic of the carcass. It is related to both grade and yield of trimmed, boneless meat; if there is too little fat at this site the carcass is liable to be placed in either the YAQ or Boner grade at a lower price than that for the GAQ/FAQ grades, which are of equal price. If there is too much fat on the exterior of the carcass it could be placed in either the Trimmer or Overfat grades. In general, the less external fat present on a carcass, the higher it will yield in terms of trimmed, boneless meat provided it is not shallow muscled and does not have a high proportion of bone.

The figures in Table 2 indicate that the two dairy breeds have less depth of fat at the 12th rib while the Angus carcasses have more than twice the depth of fat of the two dairy breeds. The Galloway carcasses had more fat depth at the 12th rib than the dairy-bred carcasses, but less than the Angus carcasses.

The cross-sectional area of the ribeye at the 12th rib is a characteristic of some importance; the larger the area the more acceptable is the steak, other things being equal. It will be noted in Table 2 that the Angus steers, on average, had the largest ribeye area, followed in decreasing order by the Friesian, Galloway and Ayrshire steers.

The colour of the fat was assessed subjectively after the carcasses had been in the chiller for 24 hours or so. The Friesian carcasses had fat which was only very slightly tinged with yellowness compared with carcasses of the other three breeds. This difference was of no commercial significance.

CONCLUSION

The evidence presented in the tables confirms that obtained in earlier trials, namely, the Friesian grows rapidly and produces a lean carcass which is usually placed in lower export carcass grades than beef-bred carcasses. In addition, Friesian carcasses have high proportions of bone and ribeye areas which are often smaller than those of the beef breeds.

The Ayrshire steers grew faster than the two beef breeds, but their carcasses had much the same characteristics as those of the Friesians. They were, however, very acceptable for dairy-beef.

The Angus and Galloway carcasses, although differing in weight by about 100 lb, were mostly similar for the various characteristics examined. In a previous trial (Barton, 1972) which included Galloway and Angus steers, the former breed produced carcasses

which were better than those of the Angus for features such as dressing-out percentage, excess fat percentage, fat depth at the 12th rib and ribeye area and their rate of daily liveweight growth was slightly faster than that of the Angus steers with which they were compared. Thus it would seem from the results of Trials VI and VII that Galloway cattle produce carcasses which may be equal to or better than those of the Angus breed in a number of important characteristics. In both trials, however, the Galloway carcasses have been lighter than the Angus carcasses. Steers of the former breed were lighter at the start of the experiment and as they grew at about the same rate as the Angus steers their carcasses would naturally be lighter even though they had a slightly higher dressing-out percentage. It is not known, however, whether Galloway weaner calves are lighter than Angus calves raised under comparable conditions.

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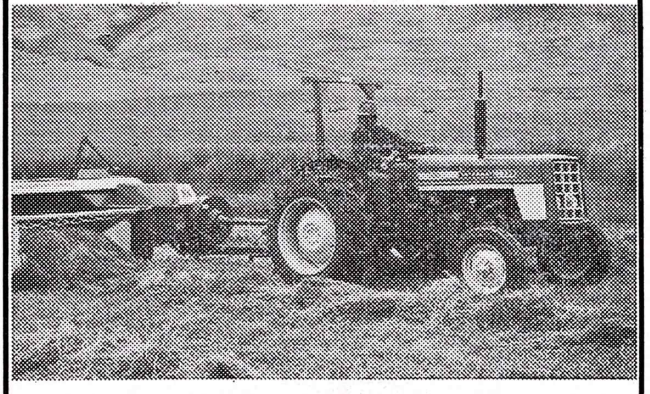

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LAMB MARKETING IN NORTH AMERICA

INTRODUCTION

R. W. CARTWRIGHT*

THE New Zealand lamb marketing operation in North America has had a chequered history. Difficulties in market development led in 1969 to formation of a consortium market organization, now popularly known as Devco. This company has continued to grapple with the complexities and dynamics of the North American market with a measure of success as well as error. Some critics of the company's operational and economic perform-

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ance have been justified, but others have failed to recognize the "hidden" benefits of re-allocating lamb supplies away from the United Kingdom.

In recent years the Devco operation has moved further towards achievement of an effective marketing mix. Earlier shortcomings in product distribution have been rectified (although others doubtless remain) and closer attention has been given to co-ordination of sales, promotion, and pricing strategies. Nevertheless, no one should claim that the operation has yet approached full development. The crucial questions that now face Devco and the New Zealand Meat Producers Board (as supervisor of lamb promotion for Devco) are:

(1) *Can* the market be developed further?

(2) If so, *how* should it be developed?

Answers to questions of this sort can be made only after a thorough examination of consumer needs, and subsequent evaluation of alternative product forms, distribution systems, promotional programmes, and pricing strategies. The symposium reported in the following pages was arranged to explore some of these issues. The two contributors are well qualified to do this. Dr Hoy F. Carman, an Associate Professor of Agricultural Economics at the University of California, Davis, has undertaken a substantial amount of research into the lamb market in the United States. He has continued this work while visiting the Massey University Market Research Centre as a Fulbright Scholar. M. A. Jones, Senior Promotion Executive with the New Zealand Meat Producers Board for some years, became the Board's Assistant North American Director in July 1973. In his new position he has responsibility for co-ordinating lamb promotion with Devco sales programmes.

The symposium papers do not answer the questions posed above, but they do provide a wealth of background material for use by managers of the New Zealand lamb marketing operation in North America. The papers also raise a number of issues that deserve immediate attention. The questions posed in the final section of Professor Carman's paper merit particular notice.

It is to be hoped that this symposium will generate further debate and introspection among producers, the meat industry, and other people who are able to contribute to the development of more effective lamb marketing systems.

THE DEMAND FOR LAMB IN THE UNITED STATES

H. F. CARMAN*

NEW ZEALAND, through the Meat Export Development Company (Devco), has invested substantial resources in establishing a profitable North American market for its lamb. Charged with this market development, Devco has established a sales network and product distribution system in the United States and Canada, conducted extensive advertising and promotion, and taken an active role in product development. Sales of New Zealand lamb in North America have increased substantially and Devco's "book losses" for its first nine years of operation have recently given way to profits (Hayward, 1972)[1]. In addition, it appears that experience gained from Devco's marketing approach will be valuable in maintaining and expanding other markets (N.Z. Meat Producers Board, 1973).

The story, however, does not end here. Devco is likely to encounter continued challenges in marketing a product which faces substantial consumer resistance. Thus, it is worth while to examine studies of U.S. consumer preferences and the demand for lamb. This paper attempts to provide a summary of demand characteristics which should be helpful in understanding some of the problems and opportunities facing Devco in the U.S. market.

LAMB CONSUMPTION

Lamb is best characterized as a minor meat in the typical United States consumer's diet. *Per capita* consumption of lamb and mutton was 3.3 lb in 1972 and averaged just under 3.4 lb for the five years 1968-72 (Table 1). Compare this with 1972 *per capita* beef consumption of 116 lb and pork consumption of

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[1]The accumulated "book losses" of some $11 million probably substantially overstate the costs of developing lamb markets in North America. There is evidence that the improvement in British prices as a result of market diversification more than covered the reported book losses (Edwards, 1970).

TABLE 1: UNITED STATES LAMB AND MUTTON, *PER CAPITA* CONSUMPTION, TOTAL PRODUCTION AND IMPORTS, 1958-72

Year	Per capita Consumption (lb)	Lamb		Mutton*		Total	
		Prodn	Imports	Prodn	Imports	Prodn	Imports
		(million lb—carcass weight)					
1958	4.2	647	6.8	41	34.3	688	41.1
1959	4.8	694	9.5	44	94.6	738	104.1
1960	4.8	722	12.4	46	74.6	768	87.0
1961	5.1	782	10.9	50	89.8	832	100.7
1962	5.2	760	13.2	48	130.0	808	143.2
1963	4.8	724	18.9	46	125.8	770	144.7
1964	4.2	672	10.4	43	68.6	715	79.0
1965	3.7	612	12.5	39	60.6	651	73.1
1966	4.0	611	14.9	39	121.1	650	136.0
1967	3.9	607	12.3	39	108.6	646	120.9
1968	3.7	566	22.9	36	124.0	602	146.9
1969	3.4	517	43.9	33	108.4	550	152.3
1970	3.3	518	43.5	33	79.0	551	122.5
1971	3.1	521	38.2	33	64.6	554	102.8
1972	3.3	501	37.3	32	111.2	533	148.5

*The volume of mutton is calculated at 6% of total lamb and mutton slaughter.

Source: U.S. Department of Agriculture (1963).

67 lb (U.S. Dept. of Agric., 1973). As a result of comparatively constant *per capita* lamb and mutton consumption with increases in consumption of other meats, lamb and mutton decreased from approximately 3.0% of total red meat consumption in 1960 to 1.7% in 1972. To place these figures in perspective, estimated 1969 and 1970 average New Zealand *per capita* consumption of beef and veal was 112 lb, sheepmeats was 88 lb, and total red meat consumption was 228 lb (N.Z. Meat Producers Board, 1973).

The number of stock sheep on U.S. farms and annual lamb crops have been decreasing steadily for the last decade. Reasons for this decrease were discussed at last year's conference by Rae (1972). They can be summarized as the switch to cattle production, predator problems, labour problems, and reduced availability of government range land. Despite higher prices for lamb and wool, there is no evidence that stock sheep numbers have yet reached an equilibrium.

Sources of United States lamb and mutton consumption during the last 15 years are shown in Table 1. Domestic production has declined with the decrease only partially offset by increased imports. United States supplies in 1972 demonstrated the following percentage composition by source: domestic lamb, 74; imported lamb 5; domestic mutton, 5; and imported mutton, 16. Almost all U.S. lamb imports came from New Zealand and Australia with each supplying about one-half of 1972 imports (New Zealand supplied 19.9 million out of 37.3 million lb).

The United States is a large market for meat. Note that if all of New Zealand's 1972 lamb exports of 337,000 tons had been sent to the United States, *per capita* consumption would have increased from 3.3 to 6.5 lb. Even with this large percentage increase, lamb and mutton would have been less than 3.7% of total United States red meat consumption.

LAMB CONSUMERS

The average consumption figures in Table 1 reveal little of the regional nature of lamb consumption. An interesting aspect of regional consumption from the standpoint of marketing lamb is the apparent concentration of lamb consumers in a few geographic areas.

Location

A detailed study of lamb and mutton production and consumption by state showed that some 70% of United States consumption was concentrated in the Middle Atlantic, North-east and West Coast states (U.S. Dept. of Agric., 1956a). In fact, almost 45% of the total was consumed in just two states, New York and California. While these states have large populations, a more important factor in the concentration of consumption was estimated *per capita* consumption of 12.3 lb in California and 11.5 lb in New York, almost three times the 1954 national average of 4.5 lb. Fourteen states, the majority located in the South-eastern United States, had annual consumption levels at less than 1 lb *per capita*.

While lacking the detail of the above study, Household Food Consumption surveys for 1955 and 1965 provide information on changes in regional consumption for four regions in the United States (U.S. Dept. of Agric., 1956b, 1968). As shown in Table 2, average United States *per capita* consumption of lamb decreased from 0.09 lb per week in 1955 to 0.05 lb per week in 1965.

TABLE 2: WEEKLY *PER CAPITA* CONSUMPTION OF LAMB BY HOUSEHOLD REGION IN THE UNITED STATES, 1955 AND 1965

Household Region	*1955 (lb/wk)*	*1965 (lb/wk)*	*Change (%)*
West	0.13	0.10	−23
South	0.02	0.02	0
North Central	0.05	0.02	−60
North-east	0.19	0.11	−72

Source: U.S. Department of Agriculture (1956b, 1968).

Changes in regional consumption varied with the largest percentage decrease occurring in the North Central region. Data in Table 2 indicate that lamb consumption became more concentrated in the Western United States during the decade 1955-65. The majority of lamb continues to be consumed in the Western and North-eastern states.

Distribution of Imports

A study of the distribution of Australian and New Zealand lamb imports for the period June 29, 1969, to July 4, 1970, shows that areas which consume the majority of domestic lamb

TABLE 3: UNITED STATES IMPORTERS' SALES OF AUSTRALIAN AND NEW ZEALAND LAMB BY STATE
June 29, 1969 to July 4, 1970

State	*Source of Imports*		*Total ('000 lb)*
	Australia ('000 lb)	*New Zealand ('000 lb)*	
Massachusetts	2,451	934	3,385
New York	3,345	3,644	6,989
New Jersey	1,489	549	2,038
Pennsylvania	1,040	967	2,007
Illinois	621	777	1,398
North Carolina	78	667	745
Florida	374	1,465	1,839
Alabama	861	92	953
Washington	114	595	709
California	1,356	4,789	6,145
Other States	2,062	3,897	5,959
U.S. Total	13,791	18,376	32,167

Source: U.S. Department of Agriculture (1971).

and mutton also consume the majority of imported lamb. States which received the largest quantities of imported lamb are shown in Table 3. Three states—Massachusetts, New York, and California—accounted for 51% of total imported lamb sales. The concentration of sales is further emphasized by noting that 70% of Australia's sales and 64% of New Zealand's sales are made in five states. Ten states accounted for 81% of total lamb imports (Table 3).

Market Segments

The concept of market segmentation is very important in the study of marketing. It is based on the observation that the buyers or potential buyers of a product, while not identical, do share certain characteristics of strategic importance in marketing. These separate groups or segments may be described in a number of ways including geographic place of residence, socio-economic characteristics, or buyer behaviour[2]. By grouping consumers into segments which are fairly homogeneous, it becomes possible to tailor marketing strategies to each segment. Since it usually requires a different marketing programme to stimulate demand among the users of a product than to convert non-users into users, it is useful to examine these groups in terms of who they are and where they are located.

Users and Non-users

In the North-east and Western areas of the United States, lamb is consumed regularly in less than 25% of the households, while in the North Central and South regions, it is consumed regularly by less than 5% of households (Table 4). For the United States as a whole, 68% of households had not served lamb during the previous 12 months. Some 93% of the households in the South served lamb less than once a month. These results are in general agreement with an earlier study sponsored by the American Sheep Producers' Council (1964).

The varying levels of lamb usage shown in Table 4 result in *per capita* consumption for consumers who use lamb being much higher than the national *per capita* estimates. Using estimates of regional population, regional consumptions, and usage rates en-

[2]For a description of the various aspects of market segmentation and the use of market segments in designing marketing programmes, see Kotler (1972) and Frank *et al.* (1972).

TABLE 4: FREQUENCY OF SERVING LAMB BY HOUSEHOLD REGION, UNITED STATES, 1967
(% of Households)

Frequency of Serving	*Region*				*U.S. Total*
	North-east	*North Central*	*South*	*West*	
Two or more times a week	2	*	1	1	1
About once a week	8	1	1	5	4
Two or three times a week	14	3	2	6	6
About once a month	11	5	3	8	7
Less than once a month	18	13	10	21	15
Not at all in past year	47	77	83	58	68

*Less than 1%.

Source: Weidenhamer *et al.* (1969).

ables one to estimate 1965 regional *per capita* consumption for those consumers who use lamb. These estimates are: West, 16.3 lb; South, 8.0 lb; North Central, 5.8 lb; and, North-east, 14.2 lb.[3] Twedt (1964) examined use levels for 18 non-durable products used in the home. The food items included three types of meat and margarine. When Twedt divided the consumers who used these products into equal groups which he called the "light half" and the "heavy half", he found that the "heavy half" accounted for 81 to 91% of the total volume of purchases. It seems reasonable, therefore, to assume that the "heavy half" of lamb consumers account for at least 80% of the total volume of lamb consumed. If so, estimated 1965 regional *per capita* consumption for "heavy half" users would have been: West, 26 lb; South, 13 lb; North Central, 9 lb; and North-east, 23 lb. With average 1972 United States *per capita* consumption only 0.4 lb less than 1965 consumption, the above patterns are probably representative of those presently existing.

Data are not detailed enough to completely evaluate characteristics of heavy *v.* light *v.* non-users of lamb, but summaries do provide some useful information. If one considers the first four categories in Table 4, those homemakers serving lamb at least once a month, the following general characteristics emerge. These homemakers tend to live in large metropolitan areas as opposed to urban or rural ones; they are over 40 years of age; family

[3]This assumes that the size distribution of user and non-user households is equal. Since there is some evidence that households using lamb are smaller, the estimates may be too low.

income is in the upper brackets, and their family is small, most likely a couple[4]. Educational level did not appear important among the heaviest users of lamb. However, the percentage of homemakers who served lamb less than once a month did increase with increases in education level.

ECONOMIC CHARACTERISTICS OF DEMAND

The term "demand" as used by economists refers to a schedule which shows the various amounts of a product that consumers will purchase at each price in a set of possible prices in a particular market at a point in time. The price-quantity relationship is inverse, that is, people ordinarily buy more of a product at a low price than they do at a high price. Note that price and quantity are the only variables; other factors such as income, population, prices of competing goods, and tastes and preferences are held constant. Given this framework, the demand for lamb in the United States and the impact of a change in the factors held constant can be examined.

The Demand Relation

The response of prices to a change in the quantity of a product sold is described by a coefficient of price flexibility. Retail price flexibilities for lamb, defined as the percentage change in price divided by the percentage change in quantity, have been estimated in a number of studies and for the postwar period range from -0.26 to -0.38[5]. A flexibility coefficient of -0.38 is interpreted as meaning that a 10% increase (decrease) in the quantity of lamb sold will be associated with a 3.8% decrease (increase) in retail lamb prices. Lamb and mutton prices are less flexible (more stable) than any other meat prices in the United States. This is due to the relative unimportance of lamb and mutton in the average consumer's food budget and the availability of substitute meats. Thus, changes in the supply of lamb have relatively little impact on the retail price of lamb.

The factors held constant in examining the relationship of prices and quantities will change the demand schedule when allowed to

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[4]For details by use category, see Weidenhamer *et al.* (1969).

[5]Estimated retail price flexibilities for lamb and mutton are: Brandow (1961), -0.31; Breimyer (1961), -0.26; Edwards (1970), -0.35; and George and King (1971), -0.38.

vary. For example, more consumers might be expected to increase the demand for lamb, which means that more lamb can be sold at the same price or that the same amount of lamb can be sold for a higher price. The potential impact of changes in population, income, prices of other meats, and tastes and preferences on the demand for lamb are considered below.

Population

Most studies which project the future demand for a product or group of products assume that a 1% population increase will increase total consumption of the product by 1% with constant real prices. There is some evidence, however, that this assumption may not hold for lamb and mutton. A high proportion of the younger homemakers do not serve lamb and even those young homemakers who do serve lamb tend to serve it less frequently than do older homemakers (Weidenhamer *et al.*, 1969). Two aspects of this consumption pattern are important. First, if the proportion of homemakers under 40 years of age expands, *per capita* lamb consumption will likely decrease, and, secondly, unless younger homemakers are introduced to lamb, the age group consumption differential will likely occur for higher and higher age groups through time.

Income

Consumer preference and household food consumption surveys show that high income households consume more lamb than do low income householders (Weidenhamer *et al.*, 1969; U.S. Dept. of Agric., 1956b, 1968). Thus, the demand for lamb might be expected to increase with increases in real income. George and King (1971) estimated the income elasticity of demand for lamb and mutton as 0.571. The interpretation of this coefficient is that *per capita* consumption of lamb and mutton should increase 5.71% with a 10% increase in real income. This, of course, assumes a constant real price for lamb and mutton and no change in real prices of substitute meats. George and King (1971) found that increases in income increase the demand for lamb and mutton more than any other meat except veal. Estimated income elasticities for beef and pork were 0.29 and 0.13, respectively.

Prices of Other Meats

Changes in prices of competing meat products will shift the demand for lamb. For example, an increase in the price of beef

TABLE 5: DEMAND INTERRELATIONSHIPS FOR MEAT AT THE RETAIL LEVEL, UNITED STATES

Quantity of	*Impact on Quantity demanded of 1% Change in Price of*						
	Beef %	*Veal* %	*Pork* %	*Lamb* %	*Chicken* %	*Turkey* %	*Fish* %
Beef	−0.64	0.03	0.08	0.05	0.07	*	*
Veal	0.36	−1.72	0.20	0.04	0.17	0.01	*
Pork	0.08	0.01	−0.41	0.06	0.07	*	*
Lamb	0.59	0.07	0.89	−2.63	0.23	0.02	*
Chicken	0.20	0.07	0.12	0.05	−0.78	0.08	*
Turkey	0.10	0.02	0.07	0.02	0.40	−1.56	*
Fish	0.02	*	0.03	*	*	*	−0.23

*Less than 0.01%.

Source: George and King (1971).

might be expected to increase the demand (and price) for lamb, with the magnitude of the increase depending on the degree of substitution between lamb and beef. George and King (1971) have estimated demand interrelationships for major meats including beef, veal, pork, lamb and mutton, chicken, turkey and fish. Their results are reproduced in Table 5. The tabled figures show the impact of a 1% change in the price of the meat listed at the top of the table on the quantity demanded of the meats listed at the side of the table. For example, a 1% increase in the price of beef will increase the quantity of lamb and mutton demanded by 0.59%. A decrease in the price of beef has the opposite effect, decreasing the quantity of lamb and mutton demanded by 0.59%.

Pork is the most important substitute for lamb and mutton, followed by beef and chicken (Table 5). Changes in the prices of veal, turkey and fish have little effect on the demand for lamb. Also of interest is that changes in the price of lamb and mutton have little effect on the demand for other meats. A 1% increase in the price of lamb and mutton would increase the demand for pork by only 0.06%. These observed relations are the result of lamb being a minor meat in the typical consumer's budget.

Tastes and Preferences

Two reports based on large consumer surveys provide information on U.S. consumer attitudes regarding lamb. Major results of the first study sponsored by the American Sheep Producers' Council (1964) concerned lamb's image and reasons consumers do not use it. With regard to these points the study concluded:

Lamb is characterised as being easy to digest, high in protein, tender, and good for young and old alike. Respondents considered lamb to be tender, although when asked to compare it with other meats they rated lamb less tender than beef, veal, pork or chicken. Some persons have the impression that lamb is a meat that persons become tired of, and others have the impression that it is expensive. Despite facts to the contrary, many persons, as indicated by the study, have the impression that lamb is not a versatile meat in terms of variety of preparation and cuts and when it can be served.

Reasons for not liking lamb were often based on misconceptions or prejudices. Dislikes included: someone in the family doesn't like it, some do not like the taste, the odor, they weren't taught to use it, and lamb is not available. Lack of availability was especially acute in the Midwestern and Southern States.

Specific action that consumers said would encourage them to buy more lamb, would be greater availability of more interesting lamb recipes and cooking instructions. They also stated an interest in canned, frozen or pre-cooked lamb.

A more recent study of consumer attitudes towards major meat products (Weidenhamer *et al.*, 1969) has similar results with some added dimensions. One portion of the survey asked respondents to specify meats most (or least) favoured for several situations. A summary of the responses for lamb follows: Meat for inexpensive meals—good choice, 1%; not a good choice, 22%. Ease of preparation—good choice, 4%; not a good choice, 13%. Meat to serve to special guests—good choice, 6%; not a good choice, 21%. Meat to serve if one were not sure of guest's preferences—good choice, 1%; not a good choice, 51%. The combined negative response to the last two questions, which were designed to provide evidence on the prestige or lack of prestige and breadth of appeal of specific meats, was higher for lamb than for any other meat considered. These results can be summarized as indicating that the average United States consumer considers lamb to be expensive, but *not* a prestige meat, difficult to prepare and undesirable to serve to guests, especially if their preferences are not known.

Non-users and infrequent users (homemakers who served lamb once a month or less often) were asked why lamb was not served or not served more often. Two-thirds (67%) of the non-users stated that it was due to preference, that they did not like lamb. Objectionable characteristics included flavour, taste and smell. Another 26% replied that it was due to lack of exposure to lamb; 12% said lamb was too expensive; and 8% said it was not available[6]. Among the infrequent users, 51% stated a negative

[6]The percentages sum to more than 100% because of multiple responses.

preference and 5% replied it was due to a lack of exposure. Over one-third of the infrequent users said that lamb was too expensive and 17% said that it was not available.

When asked which meats they would like to learn more about cooking, 8% of the respondents mentioned lamb specifically. Those respondents tend to be concentrated in the West, live in metropolitan areas, be under 40 years of age, college-educated, and in the upper income groups. Except for age and education, these characteristics described the heavy users of lamb.

Since New Zealand lamb shipped to the United States is frozen, it is worth while to summarize the attitudes of homemakers to frozen meat. While the majority of consumers sometimes freeze meat at home, they resist the concept of buying already frozen meat. Only 1% of the respondents were buying frozen meat at the time of the survey and another 13% stated they would buy meat already frozen; 6% said "It depends" and 79% stated that they would not buy frozen meat. The proportion opposing frozen meat was fairly uniform among all age, income, education, family size and place-of-residence groupings.

There is substantial evidence that United States consumers view frozen New Zealand lamb as inferior to the fresh domestic product. Retail prices for the frozen product have ranged from $0.08 to $0.80 per lb below domestic lamb depending on the cut. Legs have had the smallest differential, $0.08 to $0.24 per lb, and loin chops have had the largest differential, $0.41 to $0.80 per lb (U.S. Dept. of Agric., 1971). New Zealand frozen lamb, however, is regarded as superior to frozen Australian lamb and the New Zealand product typically fetches a higher average price.

Future Demand

United States demand for lamb and mutton has been projected to 1980. George and King (1971) estimate 1980 *per capita* consumption at 4.37 lb while Daly and Egbert (1966) estimate 3.1 lb[7]. With an estimated 1980 population of approximately 228 million, the total quantity demanded would be in the range of 707 to 996 million lb. In percentage terms, this is an increase of from 4 to 46% over 1972 consumption of 668 million lb (Table 1). It appears that these two estimates are the high and

[7]These projections are based on constant real prices at the level existing in the base period 1962-7.

low limits of what will happen. Price and quantity movements since 1966 indicate that the Daly and Egbert estimate may be too low. Likewise, George and King had evidence of a slight negative trend in demand, but since the coefficient on trend was not statistically significant it was not included in their projection. Thus their porjection is probably the higher limit.

IMPLICATIONS FOR NEW ZEALAND

The sales potential for imported lamb in the United States appears very favourable during the next decade. With increasing population, it seems reasonable to expect small to moderate increases in the total demand for lamb. Combine this with decreasing or even static domestic supply and the market potential becomes obvious. Frozen imported lamb accounted for over 9% of United States lamb consumption in 1972 with approximately one-half of the imports originating in New Zealand. While lamb imports have increased through time, they have not been sufficient to offset decreases in United States production. Past potential has been only partially realized. The question now is: "Has New Zealand learned enough about the American consumer and marketing lamb in the United States to take advantage of the future potential?" Given the distribution network established by Devco, even moderate increases above last year's volume of almost 20 million lb will result in improved returns to New Zealand producers. It is to be hoped that suspension of the diversification scheme does not reduce Devco's volume to a point where it again incurs "book losses" and loses market outlets and consumers that have been obtained at substantial cost.

A significant portion of this paper has been devoted to examining characteristics of lamb consumers, especially the "heavy users". This is necessary if one is to take a planned marketing approach. Marketing requires the identification of target consumers or appropriate market segments before the proper combination of promotion, products, prices and channels of distribution can be determined. The information presented, which focuses on the demand for fresh lamb, raises more questions than it answers about "heavy users" of New Zealand lamb. One is tempted to say that the demand characteristic for the two products is similar, that lamb is lamb regardless of source and product form. There is, however, evidence that U.S. consumers regard frozen lamb in traditional product forms as inferior to the fresh product.

About the only thing that can be said about consumers of frozen imported lamb with any degree of confidence is that they live in the same geographic areas of the United States as do the heavy users of domestic lamb. There is no published information available on characteristics of frozen lamb consumers. Hopefully, this information will be available to Devco from a recent survey done by the New York firm of Research and Forecasts, Inc., for the New Zealand Meat Producers Board (N.Z. Meat Producers Board, 1973). New Zealand learned several years ago why United States consumers were not buying frozen New Zealand lamb and corrective action was taken. To do an effective job of marketing, it is as important to know who does purchase the product and why. Consumer demand and preferences change through time and it is natural to expect marketing programmes to respond. All of this requires a continuing flow of reliable information, much of it based on carefully planned and executed marketing research.

Finally, some questions which deserve attention might be posed since decisions in these areas will influence New Zealand's future role in the United States lamb market.

(1) On which segment or segments of the United States lamb market should the Meat Board focus its attention? The present statement of basic long-range aims for New Zealand lamb promotion is, "To increase interest in the product and enlarge its acceptance . . . and to conduct promotional programmes in areas of existing and potential lamb consumption" (N.Z. Meat Producers Board, 1972). This statement is much too broad on which to base a marketing programme. To be successful it is necessary to focus on much more clearly defined targets. Promotion has been concentrated geographically, but to which segments within the selected areas?

(2) Should lamb be called lamb? There is considerable built-in bias against lamb and mutton in the United States. One need only mention the words to trigger a negative response among the majority of consumers in some areas.

(3) Is the current New Zealand product appropriate in terms of size and fatness? This question was discussed at last year's Sheepfarmers' Meeting (Barton, 1972).

(4) Could Devco do a better job of marketing if it had more control over production of lamb to meet its requirements?

Note that increased control through contractual arrangements will require premium prices. Cartwright (1973) has discussed the question of control as part of a proposed lamb marketing system.

(5) What are the appropriate product forms? The key to the U.S. market is convenience. While convenience is most important to consumers, it is also important throughout the distribution channel. Continued attention to product development is necessary.

(6) How much fabrication should be done in New Zealand? There has been an increase in centralized cutting and packaging of meat in the United States. This is a cost-saving development which appears appropriate for New Zealand. The consumer packs, presently being test marketed, are steps in this direction.

While these questions are phrased in terms of marketing lamb in the United States, they are generally applicable with minor alterations to all of New Zealand's export markets for lamb. Decisions in these areas will have important implications to sheepfarmers, the meat industry, and New Zealand.

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NORTH AMERICA — AN UNCOMMON MARKET

M. A. JONES*

THE North American market for New Zealand lamb has very great potential, but also very great problems. Its development by New Zealand is so closely enmeshed with the creation, development and operations of the Meat Export Development Company, usually known as Devco, that to discuss one is really to discuss the other.

North America is described in the title of this paper as an "uncommon" market—uncommon because:

(a) It may yet prove to be the New Zealand lamb producer's best insurance, should a situation develop where restrictive regulations are introduced for our sheepmeats in the Common Market.

(b) In North America, through Devco, New Zealand is experimenting with its first consortium-type approach to marketing.

(c) Nowhere else in the world has New Zealand a marketing operation dealing exclusively with lamb, and exclusively with lamb cuts trimmed to standard specifications and packaged for the supermarket trade.

(d) New Zealand is trying to make a success of selling a foreign, frozen lamb in a country which exhibits a strong preference for fresh meats, and in a country whose own lamb industry is declining rapidly.

North America, however, cannot be regarded totally in isolation because lamb going there from New Zealand is governed by world prices, by world demand at any particular time, and by a number of other outside influences.

AS OTHERS SEE US

For New Zealanders to begin to appreciate the tribulations in international lamb marketing it is necessary to clear up some misconceptions, and to see ourselves as others see us.

We are a nation of sheepmeat eaters; we eat, on average about 88 lb per head per year, of which some 22 lb is lamb. In our mind's eye we have a strong image of lamb—those millions of

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woolly animals that farmers crowd into roadside paddocks for the benefit of passing tourists; the roast served with green peas, potatoes and mint sauce; or sizzling chops in a frying pan. To most of us, lamb is food fit for a king—that is, if we do not prefer hogget. But that is not the way most of the world regards lamb.

In most countries, if lamb is known at all, it is subject to a host of prejudices, real or imagined. In many languages there is no word for lamb, as a meat. Often it falls into the category of sheep meat and goatmeat.

I have heard Germans and Swiss say that lamb tastes like wool, even that it smells like urine. If the Chinese know anything about lamb, it is that it should be taken more-or-less as a tonic in winter as it gives warmth to the constitution. The Japanese generally take strong exception to its cooking odour. Until the Meat Board began promotion in Japan, the Japanese language had no name for lamb; now it is *ramu*.

North America, that most sophisticated of markets, is not much more enlightened. The former chairman of the American Sheep Producers' Council commented recently that lamb is practically unknown in 40 of the 50 states.

In the Boston zoo, one may view everything from zebras to snakes, but the biggest crowd is often found clustered around a pen holding a few ewes and lambs. Does one eat animals that live in a zoo?

There are the stories of how so many American servicemen in the Pacific theatre during the war were put off sheepmeat for life by their experience with canned mutton. "But just a moment", the New Zealander might say, "that was probably old Australian mutton that could have become rancid through bad handling in the heat. Our lamb is young, tender and bland in taste and comes from the green, clean, unpolluted environment of New Zealand." To which kind of statement many an American might reply, "Oh yes, and where is New Zealand?"

Two years ago I was in the United States with a New Zealand film team. We decided to stop people at random and ask what they knew about New Zealand. This is the quickest way I know of having one's national pride deflated. As it transpired, New Zealand was everywhere from just off the coast of New England, to Europe, Asia and Africa. Those who did know it was in the South Pacific invariably and not surprisingly linked it with Australia.

I cite these examples to illustrate the problems confronting Devco in its approach to marketing in Canada and the United States. Nobody is clamouring for this frozen lamb, for this strange, foreign animal which, in carcass form, looks to them more like a dog than any other animal, and which in cuts still has little relation to beef, the universally popular meat. Very few people know enough of the right kind of things about New Zealand to make that a marketing advantage.

WHY NORTH AMERICA?

With marketing problems like these towering as high as the Rocky Mountains, why should New Zealand have wanted to try to enter this market in the first place? The short answer is that New Zealand, in the late 1950s, was becoming nervous of having almost total reliance on Britain for its lamb sales. There were a number of other reasons, too. The selection of likely alternative markets involved some fairly clear criteria and limitations. The ideal potential market had to have adequate consumer spending power to permit imports without crippling tariffs; to have some history of eating sheepmeat and to have some knowledge of handling frozen foods. That profile fitted North America and nowhere else at the time.

WHY DEVCO?

During the late 1950s there had been some quite significant sales of lamb to the United States and Canada by New Zealand exporters, but only when lamb prices in the United Kingdom were below those in North America. Obviously, in this situation, New Zealand's national needs had to be given priority over the short-term profit requirements of individual companies. Obviously again, exporting companies would take their lamb where the price was best; that kind of policy would mean off/on trading with a lack of continuity, and would not lead to orderly development.

The Meat Board, in conjunction with the export companies, decided that a consortium approach was the answer, and Devco was created in 1959.

It may not be widely realized that Devco is not a Meat Board subsidiary. It is a private company, wholly owned by the freezing companies. The Meat Board's role in the operation right from the outset was to give Devco "practical assistance" as it considered this was an undertaking in the national interest. The Board also appoints six of Devco's twelve directors.

Devco thus has sole responsibility for marketing lamb in the United States and Canada. It has been in business 12 years and its record briefly is as follows:

It has made 10 annual losses ranging from $367,000 to $1,900,000. It has made two annual profits. These were $1,144,000 in 1969, and $575,000 in 1972.

The Meat Board, paying from the Meat Industry Reserve Account, has met total losses—development costs if preferred—of about $10 million. In addition, it has spent about $4 million on promotion.

Devco's procurements of lamb in carcass equivalents have varied from 199,000 in 1961 to 1,440,000 in 1970 and a little more than one million in the present season.

To some, these figures may represent the statistics of failure. There are some very powerful arguments to the contrary which will be discussed later. First I would like to state my personal view that the Devco operation should be regarded as having two very distinct phases, the first covering the period up to 1970-71, and the second from then until the present and into the future that perhaps can already be seen to be taking shape.

THE OPENING PHASE

It seems reasonable that the very nature of Devco's task in entering a market as big and as complex as that of the United States and Canada combined had to be initially on a trial and error basis. I emphasize again that it was taking frozen lamb into an area where local producers were struggling to stay in business.

Annual consumption of lamb in the United States, for example, had fallen from 7 lb per head in the early 1940s to less than 4 lb per head by the late 1950s. The problems were massive but the potential great. The simple arithmetic of the situation was that raising the *per capita* consumption in America by 1 lb would mean a sale of 100,000 tons of lamb.

It was a trial and error operation, and it is doubtful if anyone looking back could say other than that some mighty big errors were made. But with hindsight, one has the benefit of 100% vision.

Devco's first major decision was to adopt the consignment system of selling, that is, to sell on commission through the big wholesalers and distributors who were often also packers. Devco itself paid for the storage costs and interest charges on lamb held under this system in North America.

In retrospect, this was clearly a particularly unfortunate decision. Although good commissions were offered, meat salesmen for the meat packing companies had no real zest for the job. They could sell wagon loads of beef more easily than a few lamb carcasses. And because these distributors had no financial interest in New Zealand lamb, there were occasions when they held it back, distributing instead cheaper Australian lamb which they had bought themselves. Even though the Meat Board assisted with promotion funds in Canada in 1960-1, and in the United States from 1964, factors like these gave Devco several dismal years.

Then in 1964 it seemed the breakthrough had been made. One of the big supermarket chains decided to stock New Zealand lamb across the United States and ordered quantities far beyond what were available.

Triumph turned quickly to disaster. A small number of lambs were found less than the acceptable standard of tenderness. The whole order was withdrawn.

This triumph to tragedy situation in fact proved to be a turning point to Devco's longer-term advantage. It highlighted the difference in product needs of North America and those of the United Kingdom where New Zealand had traded successfully with frozen lamb for 80 years. It particularly emphasized the different methods of the traditional British butcher shops compared with the American supermarket society. The British butcher would put his frozen New Zealand lamb carcasses into his chiller to thaw for a day or two before cutting. But in North America the cuts stayed frozen in the freezer bins of the supermarkets, and all the way along the line to the consumer who often put them into the oven still frozen. Hence the problem of toughness.

The Meat Industry Research Institute of New Zealand did some intensive work on the problem and provided an answer. This is the process known as conditioning and aging, which simply hastens rigor mortis at controlled and constant temperatures and humidity before blast freezing, and which means that lamb will be tender almost irrespective of how badly it is treated. Thus for the first time it was possible to have confidence in lamb as a product, in its quality and the consistency of its quality. All lamb for North America is now handled this way.

OTHER CHANGES

Some cuts as well as carcasses were handled by Devco from the start of its operation. But the high costs of butcher labour in

the United States brought a demand for primal cuts, at least, and by 1966 the trade had developed almost wholly into these. Canada converted fully to cuts in 1968.

The next major change was in packaging. The cuts in the early years were packed in loose polythene bags. There were complaints of freezer burn and poor product appearance. A change was made to special shrinkable film. Today, all lamb shipped by Devco is in primal cuts packaged in this film and packed in cartons weighing approximately 50 lb each. Changes in the distribution system followed. In 1970-1 Devco broke away from the consignee system and changed to direct selling to approved distributors who now include some wholesale divisions of supermarket chains. This was the end of commission selling and the introduction of outright purchase, thus providing a profit incentive for distributors.

In my view, this was the end of stage one of the operation—ten painful years in which Devco was really in search of the right kind of structure for itself, for the right kind of product, and for the right techniques. It now had lamb that could almost be guaranteed to be tender, that was in primal cuts, roller-branded with the legend "Genuine New Zealand Spring Lamb" and which was being promoted heavily through the expertise of the best agencies available in the United States and Canada. Cuts were packed in a shrink film which was attractive and gave the meat good protection. The distribution system had been changed so that companies handling the lamb were stimulated by their own financial involvement.

This was by no means the end of the difficulties. Devco was faced with strong competition from Australian lamb not subjected to the same rigid quality controls and which at times undercut New Zealand lamb prices by 20 cents a pound and more. Surveys carried out showed a tremendous prejudice against frozen lamb. We could shout from the rooftops that we had the secret of freezing tenderness into our product—the great skill—but the housewife still normally chose to buy fresh lamb, take it home and probably freeze it badly herself. Her reasoning? How could she be sure our lamb had been fresh at the time of freezing?

We still had to persuade the chains to buy our lamb. After all, they did not need it. Unless we could guarantee moving useful quantities regularly then it was just a nuisance to them. We were told that New Zealand lamb, in any case, was too small, that there was little hope of 30-pounders competing with the big, meaty samples of fresh American lamb averaging a dressed

weight of 51 lb. We had to overcome the resentment and suspicion of local producers who believed the "cheap imported lamb" would ruin their markets, especially if it were in opposition in key price-setting areas at the wrong time. We had to watch out for quotas and protectionism.

We had to try to persuade the stores to use our point-of-sale promotion materials to catch the housewife's eye and hopefully guide her hand to our product; to persuade the store manager to feature "Genuine New Zealand Spring Lamb" in his advertisements of specials in his local newspaper—usually inserted on a Thursday, and an important selling method.

There was the problem of poor equipment—inadequate display units in the supermarkets for frozen meat. Some of the refrigerated units are like lucky dips. A customer fumbles through heaps of frozen chicken perhaps to get to lamb at the bottom of the pile. This can break the wrapping film and lead to discoloration and drying of the meat.

The placing of the display unit was another important point. The housewife making her meat purchase will walk right along the line of fresh meat counters. If the freezer unit butts on to the fresh meat section then there is hope of a sale; but if it is tucked away around the corner in another department with the frozen turkeys and the frozen peas then the sales chance is greatly diminished.

We faced also a vast sales territory in terms of mileage and one over which Devco's manpower had to be thinly spread. This diversity or dilution of effort precludes using advertising widely. The cost is prohibitive. So we do not have advertising extravaganzas. Recently, however, we tried a concentrated campaign in Boston using all the media. Sales were practically doubled.

Devco employs twelve field representatives spread throughout Canada and the United States. Their task is to motivate the distributors and wholesalers, the divisional chain buyers and right down the line to the man behind the meat counter.

SOME MARKETING ADVANTAGES

Despite the problems listed, Devco does have some advantages. Surveys have shown the best locations for effort. They have shown, for example, that the middle-and-above income groups are the best targets.

We know precisely who we must aim at initially to get our particular bandwagon on the road. That man is the supermarket's

meat manager. Moreover, though he may personally hate lamb, we still know how to motivate him. Profit is the key, and his whole motivation. We are able to show him that by handling our lamb in the right way he is able to make as much per square foot of counter space as from any other meat, and usually more. He takes a mark-up of more than 30%. But we have still to educate him about the product—how to cut the primal cuts down to retail cuts; how to present it attractively, store it, prevent surface drying and so on.

We provide competitive incentives with prizes to the best salesman of New Zealand lamb in a division of a supermarket chain. They are invited in groups to lamb dinners where they are told about the bounties of nature in New Zealand that produce tender, young, bland or sweet lamb that no palate could object to. This kind of work is supported by home economists and demonstrators who prepare roasts in stores on small rotisseries and hand out samples on toothpicks. This is very successful. Store sales consistently rise when there are demonstrators present. Proof of the eating can dispel prejudices immediately, but it is a costly procedure.

The objections of American producers have been at least partially overcome by persuading them that New Zealand lamb can complement theirs. New Zealand lamb is frozen and available all year round—a tremendous advantage. And because it is frozen, it can penetrate areas outside the reach of fresh lamb.

We have joined the Americans and the Australians in a three-way promotion to build up the image of lamb *per se*—whether fresh or frozen. This must be a unique situation internationally, and surely a singular triumph for New Zealand.

Stickers are attached to all our cuts advising the consumer how best to thaw them, how long to cook them and at what temperatures. The consumer's memory is jogged with magazine and newspaper advertising, with billboards, posters etc. We run a public relations programme, using celebrity chefs and others, in the public media, and work towards greater institutional selling with programmes for home economists, hotel personnel and so on.

THE RIGHT PRODUCT

I was asked recently by a local farmer why we put such small lambs into the North American market; why there is not a

premium for bigger lambs, even hoggets. In Devco's early days the concentration was on heavier lambs, 8s and 4s. Now they are 8s and 2s, the majority being 2s with some Ds. That means the range in carcass weight has dropped over the years from, say, 36 to 56 lb to 26 to 42 lb. The heavier lambs were inclined to be fat and in any case are in short supply now; 4s represent less than ½% of New Zealand production.

Even so, there are strong beliefs that bigger and heavier lambs should be produced. It is true that the eye of meat in chops of 30-odd lb lambs is small compared with the Australian summer lamb or American lamb.

The General Manager of Devco believes larger lambs are necessary, not because the consumer demands them, but because of the sheer economics involved. In terms of time and cost, the fabrication of a small lamb is out of proportion to the fabrication of beef, pork or veal. The argument has been advanced that, increasingly, the retailers cannot afford to use expensive labour to cut up small carcasses, and if the retailer cannot, the pre-packer must. And if he cannot make money, nobody will sell lamb.

These are the worries of Devco's executives for the future and they suggest that there is a need to go back to the drawing-boards in the genetic sense to produce a lamb that reduces per-pound processing costs—but that lamb would have to be lean as well as being bigger and heavier.

The market prefers a maximum of, say, something less than ¼ in. of fat at the 12th rib; overfat lambs will kill our business faster than anything. Yet despite these points it must be said that, against all predictions, New Zealand lightweight lamb has found a niche in the North American market. The smaller 4 to 5 lb leg is ideal for many small family units. Surveys have shown that Americans in this category are not fond of cold leftovers.

Racks and loins caused many a marketing problem but in recent times have been in great and growing demand from the HRI—hotel, restaurant and institutional—trade. I was treated to a rack of New Zealand lamb (a serving for two) at a Toronto hotel last year—the cost, $16. In New York at present the retail price per pound for New Zealand loin chops ranges up to $1.98. This is more than many of the cheaper American beef cuts, but still some 75 cents per pound below the retail price of American fresh loin chops.

Our racks and loins have more than doubled in price in the past two years, mainly because of successive American devalua-

tions, but people are still buying. However, if we encounter any buyer resistance, it will be a case of the bigger and leaner the lamb Devco can get the better.

SUMMARY

Devco's situation is a great paradox. The company was created to take lamb away from the United Kingdom and thus help to improve the price there, and to maximize the overall return to New Zealand. Yet it is true that the more successful Devco becomes the greater the price it must pay for its lamb. In other words, when the New Zealand producer is having a good year with prices, Devco's task is all the more difficult from a procurement point of view.

Devco's ten losses continue to be held against it by some people, yet the only formal study of this subject, undertaken at Lincoln College, has shown that far from being a drain on New Zealand, Devco has indeed led to greater overall returns. If that is the case then those losses have not hurt any individual. The producer has still received his schedule price and the processing companies have had the benefit from greater fabrication.

On the subject of further fabrication, Devco at present is testing packs of two and four chops; in other words, getting right down to retail cuts. There has been all kinds of gratuitous advice offered by people, even in the highest positions, about how the industry must adopt these consumer cuts. Such advice should not be accepted too readily. The consumers of the world certainly want products in convenience form. They also want them as cheaply as possible. But further cutting and packaging can be done only at high cost which the market might not be able to stand.

Until recently packaging films that would give safe protection to the surface of the meat were not available at reasonable cost. The more surface exposed, the greater the risk.

Meat managers in the United States have said they could treble their sales if they could get lamb in retail packages. But when asked if they would pay five or ten cents more a pound they change their minds.

I mentioned earlier that I saw Devco falling into two stages. The first stage has been discussed; the second is this: it seems to me that Devco has now passed from the *development* stage. It has learned the basic lessons of marketing frozen lamb. It has tightened its inventory controls. It has made two profits in the past four years and is very likely to make another this year.

I do not intend to paint a rosy picture. That has been done too often before and then some circumstance has arisen to blight the situation. We have just experienced one of those blights. Devco's procurement of lambs this year is 300,000 or more below what was required, and it will probably be low in stocks for a period at the end of the year. There are a number of reasons—the drought in New Zealand mainly. Export lamb production is some 30,000 tons below expectations. This has coincided with a booming demand for red meats from all over the world. Not only North America, but Britain and other old customers have had to be rationed.

This spells the need for a major change. Devco, if regarded solely on performance since 1970-1, has done well in the face of difficulties. It should now be regarded as a commercial operation in its own right that, in a situation of changing world demand patterns, must be able to stand on its own feet, must be able to ensure that it receives its required supply of lamb, and must ensure that it can sell that lamb at a profit or close to it.

To guarantee its supplies in future, it may have to do its buying through a contract system—and that is not easy with the schedule system, or in a marketing situation where prices can vary so greatly from month to month.

It still needs help through promotion and in other ways; otherwise North America will ignore lamb, and North America is capable of absorbing a very large amount of our supply. What must not be forgotten is that North America represents our greatest insurance policy for lamb and that is a policy we cannot afford to let lapse.

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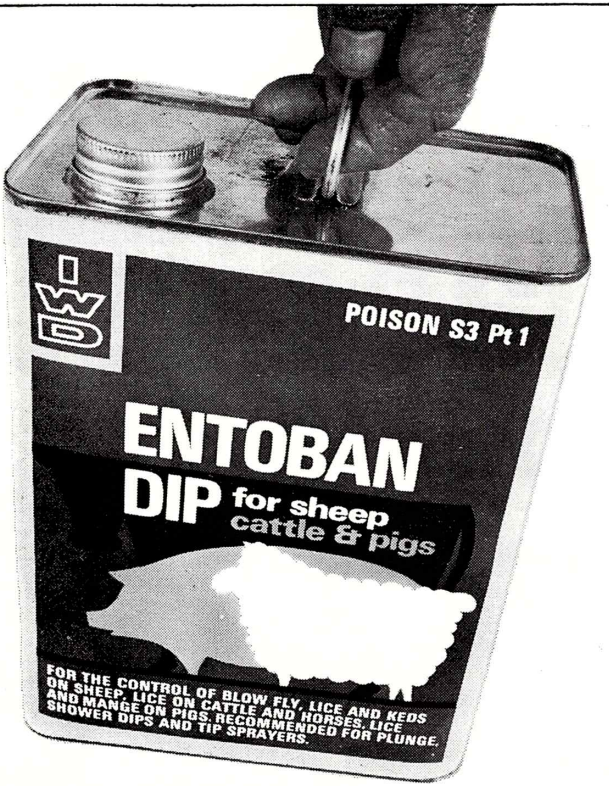
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